Volume 26 NOVEMBER 1919 Number 3

MACHINERY

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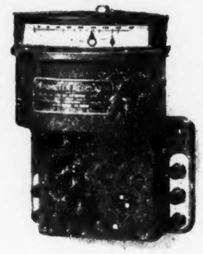

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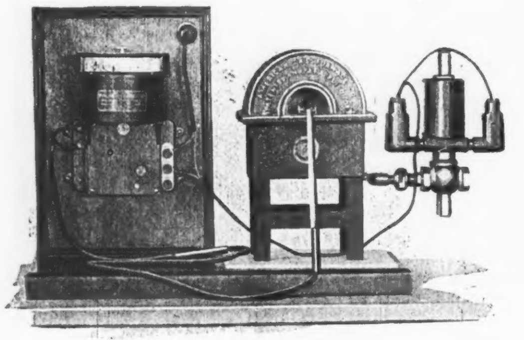

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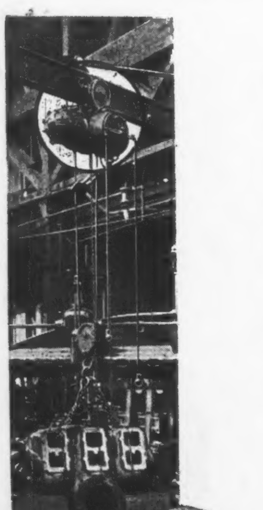

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Polishing Methods

By EDWARD K. HAMMOND

In polishing parts of metal products, there are a variety of types of equipment and kinds of abrasives which may be used. Attainment of successful results in polishing different metals is dependent upon the use of a suitable type of wheel or belt charged with abrasive material of the proper kind and coarseness to meet the requirements of the work. This article gives detailed information concerning the wheels, belts, and abrasives used by two companies which have had wide experience in the performance of polishing operations.

IN manufacturing various metal products, any of several different reasons may make it necessary to polish some of the parts. This may be done in order to improve the appearance of the surface of the metal from which a piece is made, it may be done for the purpose of preparing the work to receive some such finish as nickel plate, or certain other reasons may make it necessary to perform a polishing operation. The kind of surface that is finally produced before the product is shipped to the user will depend very largely upon the conditions under which it is to be used. For instance, machinists' scales, squares, micrometers, etc., are ordinarily finished by simply polishing the steel in order to give a uniform surface of good appearance, and one on which the graduations and figures may be easily read. Another common method of finishing is to polish the surface of the metal and then apply a coat of lacquer, in order to avoid deterioration through rust or corrosion of the metal. Still another commonly used method of finishing a polished surface is to apply a coat of nickel plate or some form of chemical treatment. Where any of these general methods is employed, the final finish produced on the work is accomplished by either electrolytically depositing nickel or some other metal, or by the action of chemical reagents upon the surface of the work. Regardless of the kind of finish that is applied to the metal, it is highly important to have a uniformly polished surface and one which is chemically clean, because in the presence of grease or any other foreign matter adhering to the surface that is to be treated by one of these methods, it will be found impossible to apply the nickel plate or the chemical treatment with sufficient uniformity to produce work of a satisfactory appearance.

Condition of a Polished Surface

The best idea of the results that are obtained through the performance of successive polishing operations will be obtained by examining the surface of the work under a magnifying glass, after taking each of the steps in polishing. Any machined surface of the work will be found covered with a series of ridges and scratches running in the direction in which the piece was passed under the cutting tool. Their coarseness will naturally vary according to the care which was taken in performing the final machining operation, but in any case it will be found impossible to produce work which will not show such defects when examined through a powerful lens. The purpose of a polishing operation is to rub down these ridges, in order that the surface may be brought to a condition approximating a perfect plane. Where the work is examined in each of the successive stages through which it passes in machining and

Fig. 1. (A) Corundum Grinding Wheel; (B) Set-up Wheel with Leather Segments mounted in Steel Frame; (C, D and F) Various Types of Set-up Wheels with Leather Face mounted on Wooden Disk; (E) Plain Felt Wheel; (G) Rag Wheel with Abrasive glued to the Polishing Surface; (H) Polishing Wheel with Face trued up to conform to Contour of Work; (I and J) Sheepskin Wheels, to be charged with Flour of Emery, Rouge, etc.; (K, L, M, and N) Grease and Fine Abrasive Material prepared in Sticks for Application to Polishing Wheels

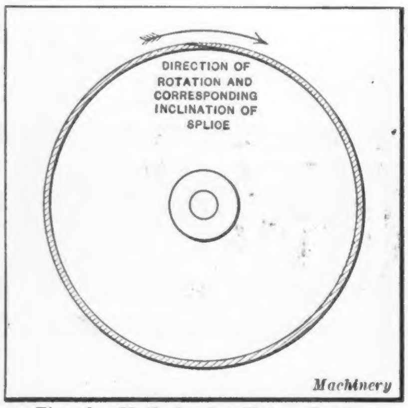


Fig. 2. Method of splicing Leather Face on Set-up Wheel

polishing, it will be quite evident that the coarseness of the ridges and valleys is reduced at each step; but in this connection, attention is called to the fact that even where the greatest care is taken in performing the final polishing operation, it is never possible to produce a surface which is not covered with a mass of scratches that will be perfectly visible if the work is examined through a glass of sufficient strength. While performing a series of polishing operations, it is the general practice to gradually reduce the coarseness of the abrasive that is used, so that the surface of the work not only approaches a perfect plane, but also has the scratches brought down to a size which represents the minimum that can be attained under the best conditions.

TABLE 1. METHODS USED BY ROYAL TYPEWRITER CO. FOR PERFORMING POLISHING OPERATIONS

Kind of Work to be Polished	Operation No.	Type of Polishing Wheel	Kind of Abrasive Used to Charge Wheel	Coarseness of Abrasive
Rough castings to be japanned	1	Grinding wheel	Carborundum	No. 30 medium grade
	2	Leather-faced set-up wheel	Emery	No. 36
	3	Loose rag wheel	Emery	No. 60
Irregular shaped work to be japanned	1	Rag wheel sewed to circumference	Emery, glued to face of wheel	No. 60
	2	Loose rag wheel	Emery	No. 90
Small iron castings	1	Leather-faced set-up wheel	Emery	No. 36
	2	Loose rag wheel	Emery	No. 60
Bronze castings	1	Loose rag wheel	Emery	No. 150
Steel stampings	1[1]	Loose-rag wheel	Emery	No. 150
German silver	1	Tumbling barrel	No. 0 pumice and water for 24 hrs.	
	2	Wooden-lined tumbling barrel and steel balls	10 lbs. white soap chips and 2 pails of water to a barrel; 10 hrs.	
	3	Nickel-plating barrel for 3 hrs.		
	4	Wood-lined tumbling barrel and steel balls	10 lbs. white soap chips and 2 pails of water to a barrel; 3 hrs.	
	5	Steam-heated tumbling barrel	Heated sawdust to dry work	
Work to be nickel-plated	1	Leather-faced set-up wheel	Emery and buffing grease	No. 150
	2	Leather-faced set-up wheel	Emery and buffing grease	No. 200
	3	Leather-faced set-up wheel from Operation 3, with grease wiped off	Emery	No. 200 (This operation "fines" work and produces a high polish.)
	4	Tampico brush	"Emery paste" (a mixture of tallow or paraffin and emery)	No. 150 emery (This operation rounds corners of work so that nickel-plate will not wear off.)
	5	Leather-faced set-up wheel	Emery greased with beeswax	Flour of emery
	6	Loose rag wheel to buff copper-plated surface	Lime	
	7	Loose rag wheel to polish nickel-plated surface	Lime[2]	

[1] Stampings must be carefully washed to remove all traces of grease before polishing.
[2] If the nickel is too rough to buff well, charge wheel with "white diamond" or rouge. Note: The above recommendations refer to the polishing of well-machined parts. Rough or imperfectly machined pieces would require different treatment.

Adopting Methods of Polishing to Suit the Work

All experienced mechanics know that abrasives are made in standard grades of coarseness which cover a wide range and that grinding wheels charged with these abrasives are held together by bonding mediums which may be selected to produce wheels conforming to various standards. In the polishing room, grinding wheels are used for the performance of a first operation where the work is of such a nature that there is a considerable amount of excess metal to be removed from the surface which is to be polished. After the preliminary operation has been performed with a grinding wheel, there are a variety of methods of performing subsequent operations. The usual practice is to employ a series of "set-up" wheels, each of which is charged with a finer abrasive than that used in making the wheel previously used, and then to obtain a final polish through the use of a rag wheel or a brush wheel, charged with some such abrasive as powdered chalk or rouge. Success in polishing depends largely upon the selection of proper grades of abrasive for performing the rough, intermediate and final polishing operations. Detailed information in regard to suitable classes of abrasives to employ for the performance of polishing operations on cast iron, steel, copper, brass, bronze, nickeled surfaces, copper-plated surfaces, and other classes of work, will be obtained by reference to Tables 1 and 2. The directions given refer to the polishing of well machined parts, and not to roughly machined pieces.

TABLE 2. RECOMMENDED PRACTICE IN POLISHING ON ABRASIVE BELT MACHINES

Kind of Work to be Polished	Operation No.	Abrasive Used to Charge Belt	Coarseness of Abrasive
Cast iron	1	Crystolon	No. 70
	2	Crystolon	No. 120
	3	Crystolon	No. 220 (for work to be nickel-plated)
	4	Crystolon	No. 220, greased (for work to be lacquered without nickel-plating)
Steel	1	Alundum	No. 70 to 90
	2	Alundum	No. 120 to 150
	3	Alundum	No. 220 (for work to be nickel-plated)
	4	Alundum	No. 220, greased (for work to be lacquered without nickel-plating)
Brass	1	Alundum	No. 320
	2	Felt belt charged with Tripoli	
Copper	1	Crocus	
	2	Felt belt charged with Tripoli	

Machinery

NOTE: The above recommendations refer to the polishing of well machined parts. Rough or imperfectly machined pieces require different treatment.

Method of Making Polishing Wheels

Mention has been made of the fact that where there is a lot of excess metal to be removed from the work to be polished, a preliminary operation is performed with a regular grinding wheel of suitable grade and grain. Such a wheel only requires an occasional dressing with a diamond or some other type of wheel-truing device in order to remove the glaze from its surface and expose a fresh layer of abrasive which has sharp cutting edges. A grinding wheel is only used in this way where the surface to be polished is very rough. Next in order of use in reducing

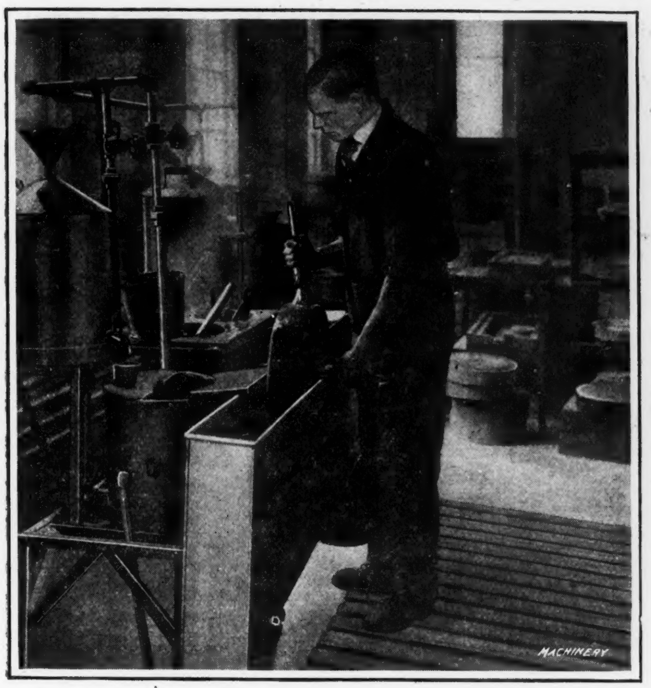


Fig. 3. Applying Glue to the Face of a Set-up Wheel

Fig. 4. Rolling Glued Set-up Wheel in Abrasive

a rough surface to a final polish comes the so-called "set-up" wheel, which may be made in either of two general ways. A common form of construction is to make the wheel of a wooden disk with a leather surface attached to its periphery. Where this form of wheel construction is used, the leather is glued to the wheel and the ends are spliced on an angle, according to the method commonly employed for making an endless leather belt with a cemented joint. It is also highly important for the lapping of these splices to be arranged as shown in Fig. 2, so that the work runs over the top of the lap without a tendency to catch the edge of the leather and open the splice. A patented form of set-up wheel is made by Devine Bros., of Utica, N. Y. The body of this wheel is made of sheet metal instead of wood, and it is of somewhat the same general form of construction as a steel belt pulley. The leather surface around its periphery is built up from laminations of leather laid edgewise, and secured to the wheel by lugs provided at the bottom of each leather segment.

Regardless of the way in which the body and leather surface at the periphery of a set-up wheel are constructed, the same general practice is employed in preparing a wheel of this type for the performance of a polishing operation. It is necessary to provide an abrasive cutting surface on the leather, which is done by first mounting the wheel on a mandrel, and revolving it as shown in Fig. 3, so that a coat of glue may be applied to the leather. Then, while the wheel is still carried on the mandrel, it is transferred to a shallow trough filled with abrasive of the desired coarseness, and the wheel is rolled as shown in Fig. 4, so that the glue-covered surface may take up the abrasive, which adheres over the entire cutting face of the wheel. It is then necessary to allow a sufficient length of time for the glue to dry, so that it will hold the abrasive securely in place on the wheel.

Before this set-up wheel can be used for the performance of a polishing operation, it must be trued in much the same way that a regular grinding wheel is trued, a diamond or

Fig. 5. Truing down the Face of a Polishing Wheel

Fig. 6. Applying Water to Set-up Wheel before scrubbing off Abrasive

Fig. 7. Rack used in Polishing Room of Royal Typewriter Co., for storing Polishing Wheels. Each Workman has a Set of Wheels and is assigned Storage Space for them on this Rack

one of the commercial types of wheel-dressing tools being used for the purpose; and the conditions under which the polishing wheel is to be used will naturally govern the way in which the dressing is done. Many wheels are trued up with a flat face, where polishing is to be done on broad surfaces, and others are dressed to a contour corresponding to the outline of the surface on the work that is to be polished. When a new set-up wheel is to be used for the first time, it is slowly rotated on the grinding stand and a stick of hard wood is pressed against the abrasive face of the wheel. The purpose of this treatment is to break up the foundation of glue beneath the abrasive, thus bringing the face of the wheel into a condition where it will yield under pressure and adapt itself to slight irregularities on the work to be polished. A wheel made in this way has a face which is slightly elastic, because the leather foundation to which the abrasive is secured acts as a cushion, and also because the coating of glue and abrasive put on the face of the wheel is not subjected to pressure, as in the case of a grinding wheel, and so is left in a somewhat springy condition. As a result, the set-up wheel is able to conform, to a certain extent, to the shape of a piece of work which is pressed against its face.

Method of Preparing Glue for Securing the Abrasive Material on Set-up Wheels

Any good quality of glue may be used for securing the abrasive to the face of a set-up wheel. It will usually be found most satisfactory to buy this glue dry and prepare it for use at the plant. The first step is to allow the glue to steep in cold water over night, a sufficient amount of water being mixed with the glue to bring it to about the consistency of dough. The glue-pot is provided with an upper compartment in which the glue is placed and heated by steam in order that it may melt and run down into a lower compartment. Too much care cannot be exercised in preparing the glue, because the use of a satisfactory quality of glue has an important influence in determining the quality of the polished surfaces that are produced by the wheel. The glue must be smooth and quite free from lumps, so that it may be spread evenly over the leather face of the wheel on which the abrasive is to be applied. The consistency of the glue should be varied somewhat, according to the coarseness of the abrasive to be used. Very fine abrasives are best held by thin glue, while a thicker glue will be required to hold coarser grained abrasives on the wheel.

Preparing Set-up Wheels for Subsequent Use

Everyone who has had experience in operating grinding machines knows that the wheels must be dressed to remove the glaze which forms on the surface of the wheel, and to expose a fresh layer of abrasive with sharp cutting edges. Repeated dressing of this kind causes a substantial reduction in the diameter of the wheel. The same reasons which require a grinding wheel to be dressed make it necessary to give similar attention to a polishing wheel; but as the covering of abrasive on such wheels does not have much depth, it will be evident that it soon becomes necessary to apply a fresh cutting surface to the wheel. This is done by first removing the worn-out abrasive, and then applying a new cutting surface according to the method which was described for preparing a new set-up wheel. For removing the worn-out abrasive, the wheel is mounted on an arbor, as shown in Fig. 6, and this arbor is placed in the bearings of a special stand, beneath which there is a tank filled with water. The machine operator then dips up a panful of this water, and pours it slowly on the set-up wheel, as it is revolved, and proceeds to scrub the face of the wheel with a piece of broken grinding wheel. In this way the accumulation of abrasive and glue is removed, after which the wheel is scrubbed with a cloth to clean the leather surface. It is then covered with glue and rolled in a trough of abrasive of the proper grade, in just the same way that a new wheel is prepared.

In the polishing room of the Royal Typewriter Co., in Hartford, Conn., it is the practice to have all of the work of preparing wheels done by men who give their entire time to this job, and hence acquire a greater degree of dexterity than would be possible if each polisher were required to prepare his own wheels for subsequent use. The life of a polishing wheel is quite limited, and so each man is furnished with several wheels, in order that he can send one of them to be re-surfaced and start using another wheel

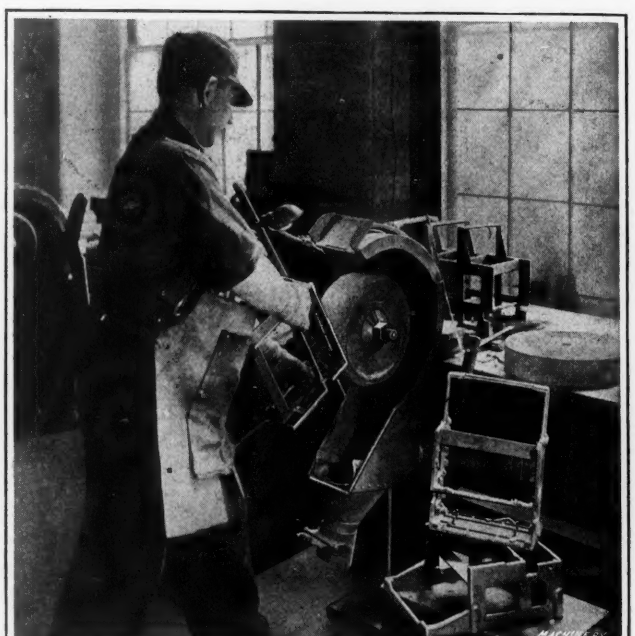


Fig. 8. Second Operation in polishing Royal Typewriter Frames

without delay. Each of the men in the polishing room is furnished with a regular set of wheels, and racks are provided on which each man is allowed a definite amount of space marked with his time-clock number. Fig. 7 shows one of these racks, and also an arbor press that is used by the polishers to force the arbor into or out of the wheel, at the time they are starting or completing the work of re-surfacing.

Felt and Rag Wheels for Final Polishing Operation

As their names imply, felt wheels and rag wheels are made of the materials from which they are named. Both of these types of wheels are built up by sewing together disks of felt, or round pieces of cloth. There is a considerable variation in the practice of making wheels of this type, although the general method of procedure is uniform in all cases. In the case of cloth wheels, the usual method is to make up bunches of cloth of about ¼ inch in thickness, with all of the pieces of cloth in a bunch securely sewed together for a distance of about 2 inches from the center. From this point to the periphery, the individual pieces of cloth which make up one of these bunches are left loose. A rag wheel is made by assembling together on an arbor the proper number of bunches to give the required face width. It will be quite apparent that when a rag wheel is at rest, it would not have sufficient stiffness to enable the periphery of such a wheel to perform a polishing operation; but when the wheel is driven at a rotative speed which corresponds to a peripheral speed of from 5000 to 7500 feet per minute, it will be apparent that the action of centrifugal force on each of the cloth disks composing such a wheel causes these disks to stiffen up and gives them plenty of resiliency for polishing the work. Felt and rag wheels used for the performance of final polishing operations are usually charged with some very fine abrasive such as rouge. Detailed information concerning the abrasives to use on different polishing jobs is presented in tabular form.

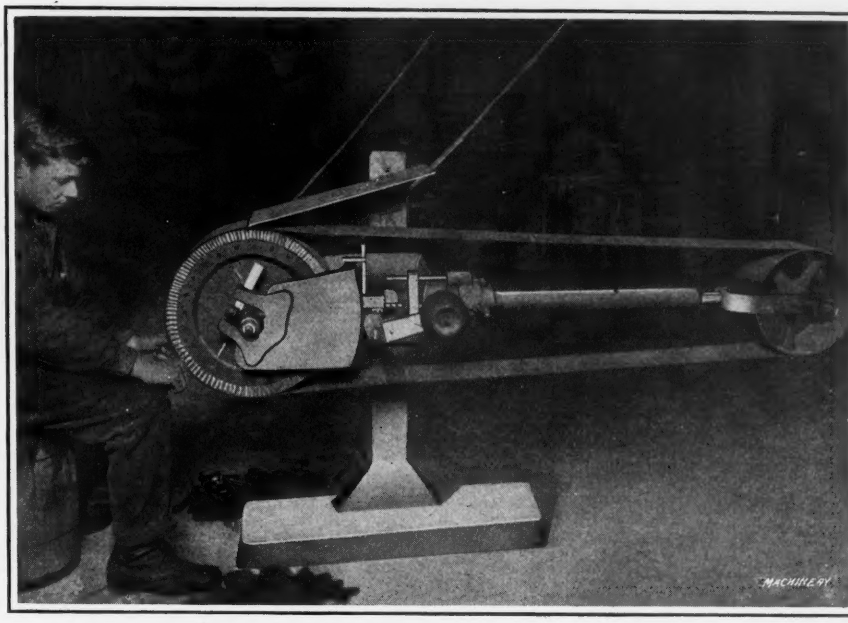


Fig. 10. Abrasive Belt Type of Polishing Machine with a Leather Wheel to support the Polishing Belt

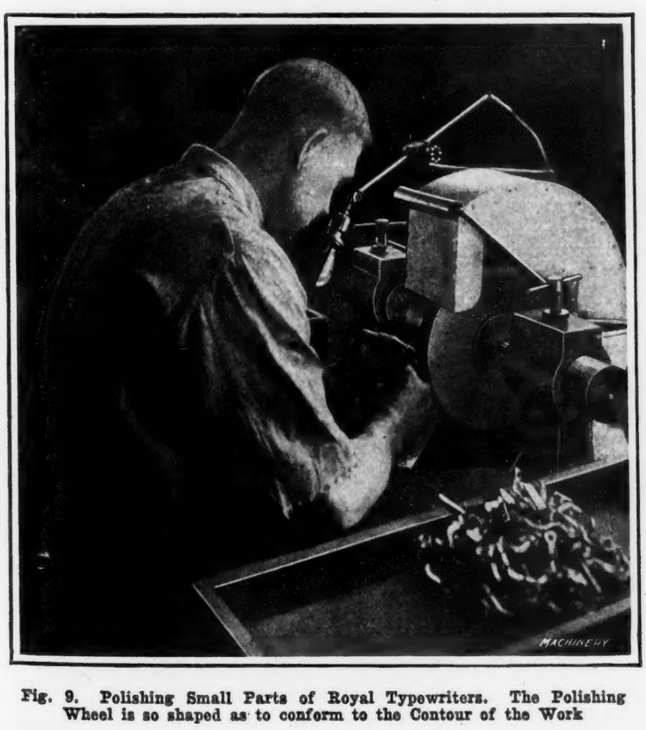


Fig. 9. Polishing Small Parts of Royal Typewriters. The Polishing Wheel is so shaped as to conform to the Contour of the Work

Importance of Keeping the Work Clean while Polishing

In one of the preceding paragraphs, attention was called to the fact that where a polished surface is to be nickel-plated or subjected to some method of chemical treatment, it is necessary to have the work perfectly clean before such a treatment is applied. This point is reiterated at this time, in order that the previous statement in regard to the importance of cleanliness may not be confused with another condition which must be fulfilled if successful results are to be obtained in the performance of polishing operations, namely, that the greatest care must be taken not to allow grease or dirt to drop on the polishing wheel or work while the operation is being performed. Where this precaution is not followed great trouble will be experienced through having long smears produced across the polished surfaces, which will quite destroy the appearance of the product. An explanation of the way in which such defects are produced may well be given in connection with a description of the action of a polishing wheel. During the preliminary operations in polishing, where coarse abrasives are used, the individual grains of abrasive cut off chips of metal; but in performing the final operations by wheels charged with the very finest abrasives, the action is believed to be one of rubbing down the surface of the metal to a uniform level, instead of actually removing chips.

At the high speeds at which a polishing wheel is driven, it is the theory of experienced polishers that the wheel has a tendency to remove the tops of the microscopic ridges on the work, to which reference has been made, and press the metal so removed down into the spaces between adjacent ridges, thus reducing the work to a plane surface. If any grease or dirt drops on the wheel or work, it will be apparent that this shifting of the metal over the surface of the work will result in amalgamating the foreign matter with the metal, thus producing a smear of unsightly appearance. A distinction must be drawn, however, between the undesirability of having grease drop on the work, and a quite general practice in polishing rooms of applying grease to the surface of the polishing wheel in order to produce a very smooth finish. One kind of grease used for this purpose consists of a mixture of two parts of hide scrapings to one part of paraffin, although a perfectly satisfactory grease may be bought under the commercial name of "buffing grease," or "buffing tallow." The reason that applying this grease to the wheel does not produce the smears on the work, to which reference has been made, is due to the fact that the grease is uniformly distributed over the wheel and work, instead of being applied merely at one point. It is

the practice to use a greased wheel for the final polishing operation, as experience has shown that the application of grease to the wheel results in rubbing the work down to a smoother polish than could be obtained from the application of an ungreased abrasive wheel to the work. This practice of greasing the wheel gives it a more uniform cutting action, and prevents the abrasive from making visible scratches on the work. As a result, a greased wheel is able to produce a higher polish.

Abrasive Belt Polishing Machines

So far, this discussion has been concerned with the use of circular wheels for the performance of polishing operations. However, there is another type of polishing machine which is constantly increasing in popularity as it becomes more generally known to the trade. This is the abrasive belt polishing machine which is built in a number of different types. They all operate on the same basic principle, namely, of having a belt charged with abrasive driven over the surface of the work, which is held in contact with the abrasive belt through the application of pressure. Two general principles are employed by the Blevney Machine Co., of Greenfield, Mass., for supporting the endless abrasive belt used on these machines, which consists of a fabric charged with an abrasive of a suitable coarseness. This belt would not be strong enough to withstand the pressure with which the work must be applied to the abrasive, unless the belt was properly supported. These two methods of support consist of either having the abrasive belt run over a leather faced wheel which is built up of segments of leather placed edgewise, or of having the abrasive belt backed up by a corrugated leather belt. Machines equipped with these two types of support for the belt are shown in Figs. 10 and 11, respectively.

How Cuttings are Cleared from the Abrasive Belt

Experiments conducted in the laboratories of the Norton Co., of Worcester, Mass., have shown that the abrasive belts used on these polishing machines cut elongated chips from the metal, and that they do not remove the material in the form of dust. It is important to provide for clearing the cuttings from the abrasive belt, because if this were not done, the belt would soon become so heavily charged that it would fail to operate efficiently. The arrangement of the laminated leather wheel or the corrugated leather belt provides for such elimination of cuttings. The way in which these results are accomplished is best shown by the diagrams Figs. 12 and 13, which show enlarged views of a section of the laminated wheel and of the corrugated leather belt, respectively. In the case of the wheel, Fig. 12, it will be apparent that the leather laminations show a tendency to bend backward when the work is pressed against the belt carried by them. This backward bending of the corrugations causes small spaces or pockets to develop beneath the belt, which allow the belt to be depressed sufficiently to form the required amount of chip clearance between the belt and the work. In this way, provision is made for carrying the chips along beneath the work, without causing them to be deeply embedded in the texture of the belt; and as soon as the belt and chips pass out from under the work, the tension on the belt causes it to straighten out with a snap, and in this way throw the chips clear of the belt.

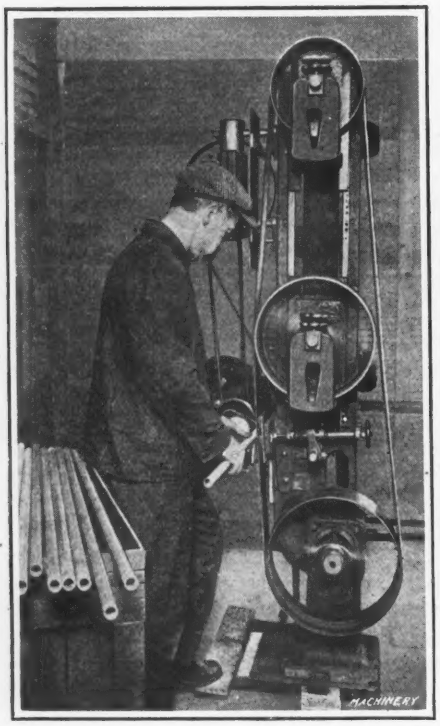


Fig. 11. Abrasive Belt Type of Polishing Machine with a Corrugated Leather Belt to support Abrasive Belt

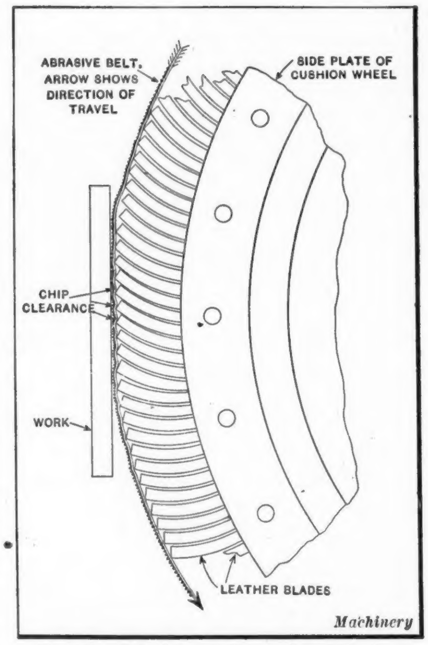


Fig. 12. Principle of Supporting Wheel on Machine shown in Fig. 10

After one of these laminated wheels has been used for some time, a tendency will be shown for the leather laminations to take a permanent set in the direction in which they have been bent backward. If allowed to develop without correction, the amount of this set would assume objectionable proportions; and to overcome trouble from this source, provision has been made for lifting the complete unit consisting of the leather cushion wheel, with its spindle and bearings, out of the support in the frame, allowing the operator to reverse the leather wheel on its spindle and replace the unit with a minimum amount of labor. By adopting this practice, it will be apparent that the laminations which were formerly bent backward are now leaning toward the front, so that when pressure is applied to the abrasive belt and laminations, they will first be pulled over to the center point and then back to the position indicated by the diagram. Reversals of the wheel can be made with very little loss of time.

The corrugated leather supporting belt, shown diagrammatically in Fig. 13, functions essentially the same way, in so far as clearing the chips from the belt is concerned. It will be apparent from the diagram that the corrugations in this belt enable clearance pockets for the chips to be formed between the abrasive belt and the work; and after the belt passes out from under the work, its tension causes the belt to straighten out with a snap and throw the chips clear in the same way that this result was accomplished by the laminated leather wheel.

Attachments for Abrasive Belt Polishing Machines

For use on the abrasive belt polishing machines built by the Blevney Machine Co., Greenfield, Mass., a number of different attachments are made, which facilitate the performance of polishing operations on various special classes of work. Machines equipped with many of these special devices have been illustrated and described in the New Machinery and Tools section of MACHINERY, so that it is unnecessary to enter into a complete description at this time. It may not be out of place, however, to state that these special attachments include feed-rolls for automatically passing cylindrical shaped rods and tubing across the face of the abrasive belt; racks for use in connection with the feed-rolls, to provide for supporting the long pieces of cylindrical work; multiple work-carrying fixtures for holding a number of small or medium sized pieces of work in

contact with the abrasive belt; and various forms of work-rests for holding a single piece of work while the polishing operation is performed on it.

Coarseness of Abrasives Used on Polishing Belts

In Table 2 there are presented recommendations for the performance of polishing operations on abrasive belt machines. The data in this table give a general outline of practice for polishing several of the most commonly used metals. While a general table recommending the abrasive to be used in polishing will be of assistance to an operator using abrasive belt machines, a knowledge of the work in hand, the kind of metal to be finished and its condition preparatory to finishing is necessary before the selection of the proper abrasive can be made. For instance, rough castings or imperfect parts require a different treatment from well machined pieces, such as articles of steel that are nicely machined and ground and require only the very finest polish, for which one operation would probably be adequate. The table is made up for well machined parts, such as might be produced on an automatic screw machine—pieces that have been given a fairly good finish and which must subsequently be polished.

Crystolon and alundum are recommended as cutting abrasives for ordinary finishing, but where the finest polishing is required and it is necessary to color, such as on nickel and brass work, there are various compositions such as tripoli, crocus, white polishing composition, Vienna lime and rouges. Tripoli is made with cutting, polishing and coloring qualities, and is used on steel, cast iron, brass, etc., for fine polishing. Crocus is especially suited for the smooth finished surface on cast iron and steel, and is sometimes used on brass, although it has a tendency to discolor this metal. Crocus is used a great deal by stove manufacturers for finishing cast iron, also on steel parts such as are used on sewing machines, automobiles, bicycles, etc.

White polishing composition is used for the polishing of nickel or brass after plating, and in some cases solid metal which is not plated. This composition is used to good advantage on heavy nickel-plated work which is both cut and polished at the same time, after which a final polish or color is given with a composition such as Vienna lime. White composition can also be purchased for polishing and coloring all metals where a high color is required and for extra fine polishing of silver. Vienna lime is used in different grades, and it is necessary to know what class of work is to be polished before any particular grade can be recommended. It is used for nickel polishing. Rouges are used for both coloring and polishing, and are made in red and black colors, the former more generally for steel and the latter for horn, rubber, celluloid, and sometimes metals.

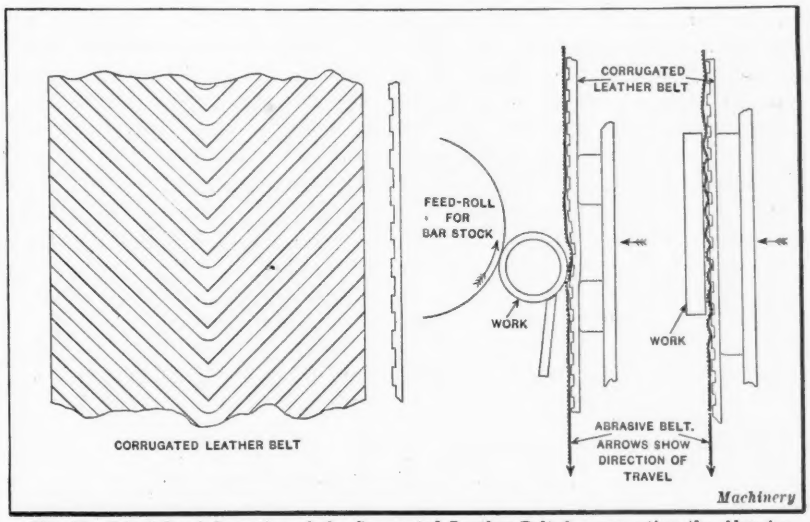


Fig. 13. Principle of Operation of the Corrugated Leather Belt for supporting the Abrasive Belt used on the Machine shown in Fig. 11

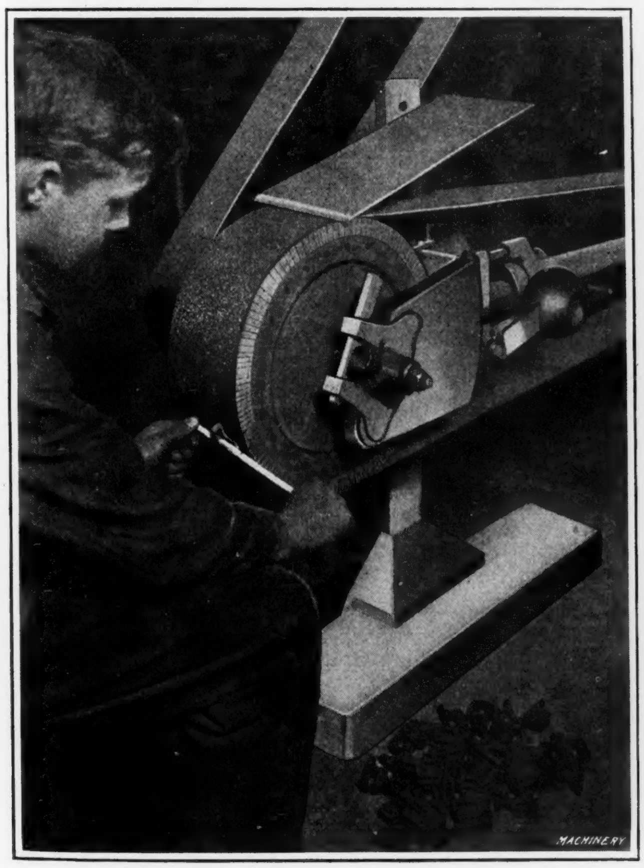


Fig. 14. Close View of Polishing Operation performed on a Machine of the Type shown in Fig. 10

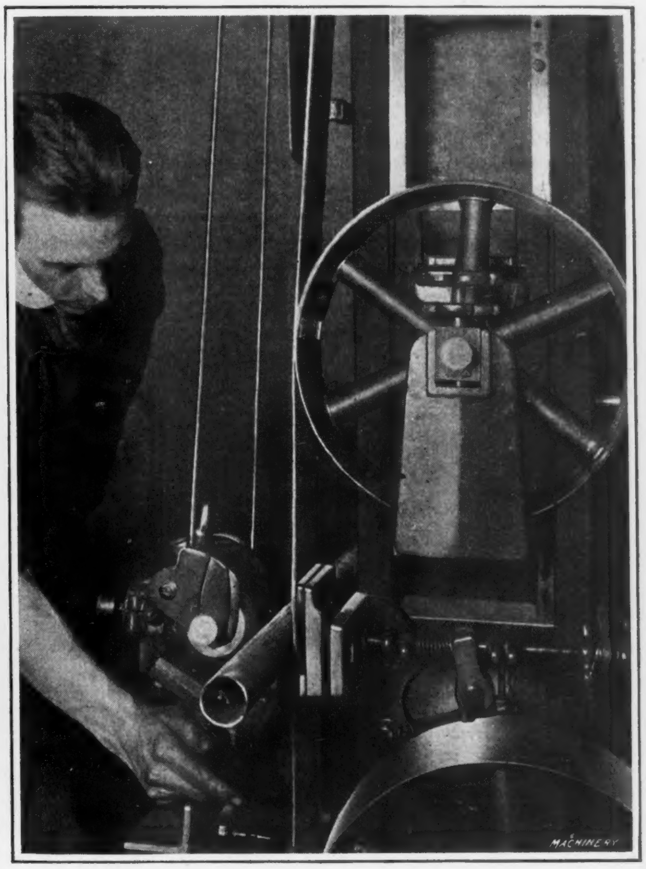


Fig. 15. Close View of a Polishing Operation performed on a Machine of the Type shown in Fig. 11

It will be well to present a few supplementary suggestions concerning the preparation and use of abrasive polishing belts. In every case, the abrasive must be fine enough for each operation, so that it does not produce scratches on the work; otherwise, time will be lost in removing these scratches before any really effective polishing can be done. The coarsest abrasive recommended in Table 2 is No. 70 which is for use on cast iron or steel. For very rough work, however, it may be found more desirable to take the preliminary cut with a belt carrying No. 46, after which an intermediate cut will be taken with a belt carrying No. 90, followed by a finishing cut taken with a No. 180 belt. Where a very fine finish is required, the work will be given a fourth operation, and the belt used for this purpose will be No. 220 greased. It is common practice to rub down used belts with an old file or stone and then grease them for the final polishing operation. In this way, the effective use of the belts is greatly increased. After all of these pieces have had the third operation performed on them, the abrasive on the No. 180 belt will be rubbed down and the belt will be greased ready for performing the final polishing operation. It will, of course, be understood that the recommendations made in Table 2 are only a statement of average practice. On some classes of work, such as polishing flat-irons, very satisfactory results have been obtained through taking the preliminary cut with a belt charged with No. 90 alundum, and then finishing the work with a No. 220 greased belt. One well-known firm obtains good results by polishing the work with a belt charged with either No. 70 or 100 alundum, and then using the same belts for a finishing operation, after they have become too badly worn for use in taking the preliminary cut. The abrasive is rubbed down with a file stub or piece of stone, and the belt is greased to adapt it for performing the final polishing operation. On all classes of polishing operations, regardless of whether they are performed on abrasive belt machines or polishing stands, the selection of abrasives and methods of procedure must be based on judgment acquired through the actual performance of polishing operations under the conditions that exist in the shop where the work is to be done.

Methods of Electroplating

To those who are not familiar with the lay-out of industrial plants in which a lot of electroplating and polishing work has to be done, it may appear that the presentation of suggestions for the performance of electroplating operations are out of place in an article dealing with methods of polishing. It will usually be found, however, that there is a very close relationship between the polishing and electroplating departments of a factory, because the work has to be passed back and forth between these two departments in order to perform successive plating and polishing operations. In Table 1, information is given concerning the types of wheels and abrasive materials to use for polishing work preparatory to nickel-plating and for producing a satisfactory surface on the nickel or other metal which is electrolytically deposited on the work. To supplement this information, the following outline is presented of methods of plating which are employed at the plant of the Royal Typewriter Co.

On large flat surfaces it is the usual practice to first polish the surface that is to be nickel-plated and then apply a coating of copper, in order to protect the work against rust or corrosion. The copper is applied to the work by dipping it into a boiling solution of copper sulphate, after which the work is buffed with a loose rag wheel charged with powdered lime, to produce a uniform surface on which to deposit the nickel. Next, the work is "flashed," which is the name applied to the process of dipping the polished copper-plated parts into the electroplating bath, in order to roughen the surface of the copper very slightly and provide an anchorage for the nickel-plate. To obtain satisfactory results in the performance of nickel-plating operations, it is highly important to have the work perfectly clean before it is placed in the electroplating bath. For this reason, the next step is to clean the copper-plated parts in a hot solution of "Wyondotte special," which is made up by adding 5 gallons of the Wyondotte compound to 50 gallons of water. This solution is used at a boiling temperature. If the work is at all greasy, a hot solution of whale oil soap is next used to wash off the grease. In any case, the work is next dipped in a 5 per cent solution of muriatic acid which is used cold, after which it is thoroughly washed in cold water.

After being washed, the work is placed in a cold electroplating bath containing a 20 per cent solution of nickel cyanide, care being taken to maintain the strength of this bath constant by adding nickel cyanide as the solution becomes weakened through the withdrawal of nickel that is deposited on the work. The bath is maintained at a specific gravity of from 6 to 8 degrees Baumé; and when the gravity drops below 6 degrees Baumé, the strength is increased by adding nickel salt. The length of time required for nickel plating is two and one-half hours, if the work is to be buffed, because it is necessary to have a deposit of nickel about 0.001 inch in thickness. Six amperes of electric current are delivered to the plating bath under a potential of from 2½ to 3 volts. The work is washed in cold water, after being removed from the electroplating bath. If it is only required to produce a "white" nickel-plated surface, that is, without buffing the nickel, the work is only left in the bath for one and one-half hours, because none of the nickel so deposited is removed by the buffing wheel. If the nickel deposited on the work is too rough to be buffed well by a wheel charged with lime, it should be polished with "white diamond," or rouge, if white diamond fails to give the desired results. Where a very high finish is not required, it is unnecessary to buff the copper plate on which the nickel is deposited.

* * *

GOVERNMENT SURPLUS STEEL

The War Department authorizes publication of the following statement from the office of the Director of Sales: The Director of Sales announces that the War Department held as surplus in October, approximately 400,000 tons of iron and steel. This aggregate embraced raw, semi-finished and finished steel, also alloys, and iron and steel scrap. All of this surplus is now being offered for sale either by negotiations, or under sealed bids. The greater part of the surplus, or 391,617 tons, is held by the Ordnance Department. The comparatively small balance is distributed between Purchase and Storage Division, Air Service, Chemical Warfare Service and the Signal Corps. The surplus stocks of iron and steel are widely scattered throughout the country, the larger tonnages being located east of the Mississippi at those plants which were engaged, during the period of the war, in the manufacture of munitions. The War Department is now prepared to pass promptly on all offers made for these iron and steel stocks, and to expedite delivery. Inquiries relative to these surplus stocks should give specifications of the materials desired, and should be addressed to Chairman, Ordnance Salvage Board, Ordnance Department, Munitions Bldg., Washington, D. C. or to the nearest of the district ordnance offices located throughout the country.

* * *

In 1913, Germany exported to Italy more machinery than all other nations combined. The United Kingdom took the second place; Switzerland, third; France, fourth; Austria-Hungary, fifth; and the United States sixth. In 1918, the United States took the first place, with the United Kingdom second, and Switzerland third. Nearly all of the machines imported from the United States were in the machine tool class, valued at nearly $30,000,000, at normal exchange. Although there is a considerable depression in all industries in Italy at present, there is great industrial activity in view, provided some of the difficulties relating to unfavorable exchange, labor unrest, etc., can be overcome.

ERROR IN LEAD OF SPIRAL GEARS

By NIKOLA TRBOJEVICH

When hobbing spiral gears on an ordinary hobbing machine, two sets of change-gears are employed to produce the required lead of the helix—the so-called index-gears and the feed gears. In practice, change-gears can very seldom be found which will give the exact theoretical ratio, and usually a more or less close approximation to the theoretical figure must be used, this discrepancy constantly affecting the lead and the angle of the gears. It is generally known that but a slight error in the gear ratio will cause a considerable change in the lead of the gear. It will be of interest to know in just what proportion these two errors are to each other, and also to know more about the factors which enter into and control the errors. Assuming that the feed gears are exact, a condition which is always easily fulfilled, a simple fraction may be chosen for the feed which can accurately be expressed by a train of gears.

The formula for finding the index-gears on a hobbing machine is:

$$R = \frac{KL}{N(L-F)} = \frac{\text{driver}}{\text{driven}} \qquad (1)$$

where R = ratio of index-gears;
K = a constant;
N = number of teeth in gear;
L = lead of gear;
F = feed per revolution of gear.

The value of the constant K depends upon the make of the gear-hobbing machine. For a Gould & Eberhardt machine it is 60; for a No. 12 Barber-Colman, 30, etc.

In Equation (1), R and L are the variables. We differentiate with respect to L:

$$dR = \frac{K}{N} \times \frac{L-F-L}{(L-F)^2}\,dL = -\frac{K}{N} \times \frac{F}{(L-F)^2}\,dL \qquad (2)$$

where dL = the error in lead, and
dR = the error in ratio.

As the feed is usually very small in comparison with the lead (in many cases only about one-tenth of 1 per cent of the latter), we shall commit no appreciable error by substituting L^2 for $(L - F)^2$ in Equation (2):

$$dL = -\frac{N}{K} \times \frac{L^2}{F}\,dR \qquad (3)$$

Let us now analyze Formula (3):

1. Provided the hand of the hob is the same as that of the gear, a ratio *greater* than the theoretical figure will make the lead *shorter*, and a *smaller* ratio will make the lead *longer*.

2. The error in lead, dL, increases very rapidly with the square of the lead on large gears having comparatively small helix angles. A fairer comparison is obtained, however, by considering the relative error, that is, the *error per inch of the lead*:

$$\frac{dL}{L} = -\frac{N}{K} \times \frac{L}{F}\,dR$$

Even then, the error is still proportional to the lead.

3. A more accurate lead may be obtained on hobbing machines of similar construction, having a greater constant K. As K is usually equal to the number of teeth in the index- or table-worm gear, a machine having a large index-gear will produce a more correct lead.

4. A coarse feed will give a more accurate lead than a fine one, other things being equal.

The Error in the Angle

On all spiral gears, the following formula holds good:

$$\sin a = \frac{PN}{L}$$

where a = the helix angle, and
P = the normal circular pitch.

Consider a and L as variables, and differentiate with respect to a:

$$\cos a\,da = -\frac{PN}{L^2}\,dL = -\frac{\sin a}{L}\,dL$$

from which

$$da = -\frac{\tan a}{L}\,dL \qquad (4)$$

Example Demonstrating Application of the Formulas

In the following example, the figures for which are taken from a problem in toolmaking which actually arose in practice, the use of the formulas deduced in this article will be demonstrated. It was desired to hob a spiral gear of the following specifications: 6.6759-inch lead, 12 teeth, left-hand gear, left-hand hob, 45-degree helix angle, 0.015-inch feed, constant 60, on a Gould & Eberhardt machine.

$$R \text{ (theoretically)} = \frac{KL}{N(L-F)} = \frac{K}{N} \times \frac{1}{1-\frac{F}{L}}$$

$$= \frac{60}{12} \times \frac{1}{1-\frac{0.015}{6.6759}} = \frac{1}{0.199551}$$

The *actual* index-gears were:

$$\frac{89}{37} \times \frac{75}{36}\,\frac{\text{driver}}{\text{driven}} = \frac{1}{0.1995505}$$

$$dR = \frac{1}{0.199551} - \frac{1}{0.1995505} = -\frac{0.0000027}{0.1995} = -0.000013$$

It will be noted that all formulas are presented in forms by which we are enabled to obtain the required accuracy without much "long-hand" figuring, and to do practically all the work on a 20-inch slide-rule.

Substituting the values in Formula (3):

$$dL = -\frac{12}{60} \times \frac{6.676^2}{0.015} \times -0.000013 = 0.0075 \text{ inch}$$

That is, the actual lead is 0.0075 inch longer than it should be theoretically, in spite of the fact that the gear ratio was accurate to within five places.

The error in angle—see Equation (4)—is

$$da = -\frac{\tan a}{L}\,dL = -\frac{0.0075}{6.676} = -0.0011 \text{ radian}$$

and the actual angle of helix is therefore 0.063 degree less than it should be, or 44 degrees 56 minutes. The foregoing example shows that in problems of this and of a similar nature, an extraordinary accuracy is required in calculating the index-gears.

* * *

USE OF BARIUM-CHLORIDE IN ELECTRIC HARDENING FURNACES

More than ten years ago electric hardening furnaces using barium-chloride were introduced for the heating of high-speed steel for hardening. These did not prove as successful at that time as had been expected on account of the manner in which the barium-chloride seemed to attack the high-speed steel. Recently built furnaces utilizing this principle have, however, been successfully employed for heating ordinary carbon steel for hardening and also for tempering purposes. One of these furnaces is used in the South Philadelphia works of the Westinghouse Electric & Mfg. Co. It consists of an outer shell, a cast-iron cylinder packed with fire-brick, and a layer of asbestos. The current is supplied by two pairs of electrodes built into the opposite sides of the walls of the inner chamber. Carbon rods are placed between these electrodes to complete the circuit when starting the furnace. After the current is turned on, the barium-chloride melts and completes the circuit without the aid of the carbon rods, which are removed. The furnace throws off very little heat—a feature which is appreciated in the hardening room.

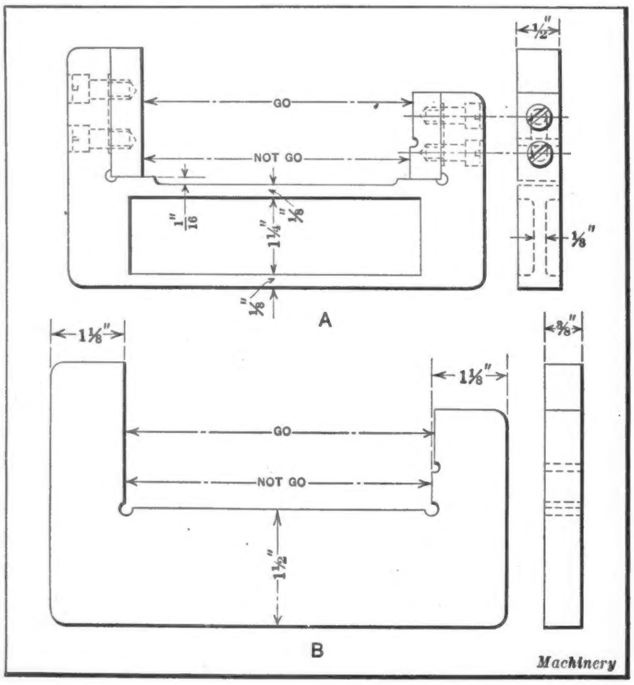


Fig. 1. Standard Snap Gages for testing Length

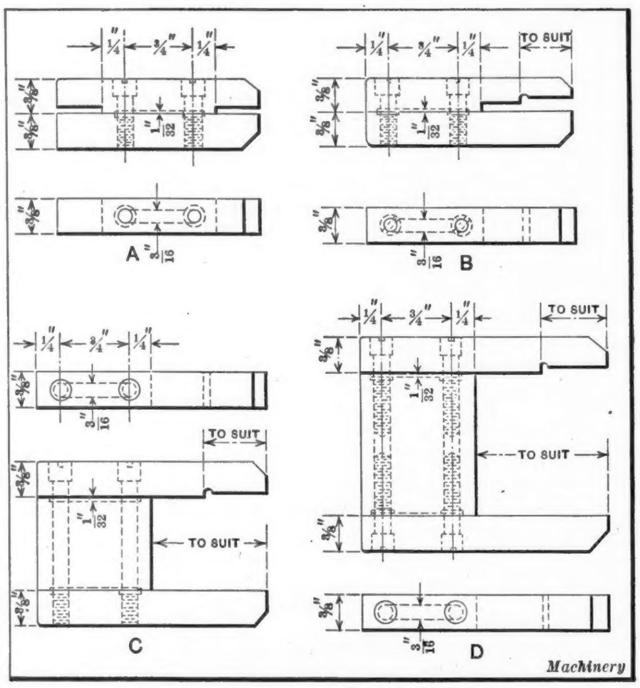


Fig. 2. Standard Snap Gages, Two-piece Construction

Snap, Plug and Ring Gages

By J. E. COLLINS

IN the October number of MACHINERY, the general requirements in gage-making were dealt with in the article entitled "Standardized Gages for Interchangeable Manufacture."

The present article will deal more in detail with snap, plug, and ring gages, giving exact information as to methods of construction and proportions, tolerances, etc. The article is based upon the practice of the Gage Division of the Ordnance Department during the war, and embodies the experience and knowledge gained in this department during a long period of development, until the principles here laid down finally crystallized into a standardized system.

Snap Gages

There are two distinct types of snap gages in common use—the built-up type and the plate type. The built-up design is far superior, but is more expensive. The plate type is machined to the correct outline from a single piece, and is therefore simpler and less expensive to make, as no fitting together of parts is required when gages are made this way.

The standard snap gages illustrated in this article are designed for gaging diameters or lengths of work from 0 to 3 inches. For gaging diameters over 3 inches, snap gages are generally of the C-type and may be purchased directly from gage manufacturers, either in the rough state or completely finished. The C-type of gage is illustrated in Fig. 3 from which a good idea of its general proportions may be had. The size shown when obtained in the rough forging has an opening *A* between the gaging surfaces of 2 5/16 inches. This opening can be finished to gage work up to 3½ inches in size. Snap gages for gaging dimensions greater than 3 inches are considered special, and are made in both plate and built-up designs. Two gages illustrating these types are outlined in Fig. 1. The built-up design *A* has a machine steel body and hardened and ground tool steel gaging surfaces, while the type shown at *B* is made from one piece of pack-hardened machine steel, with ground gaging surfaces.

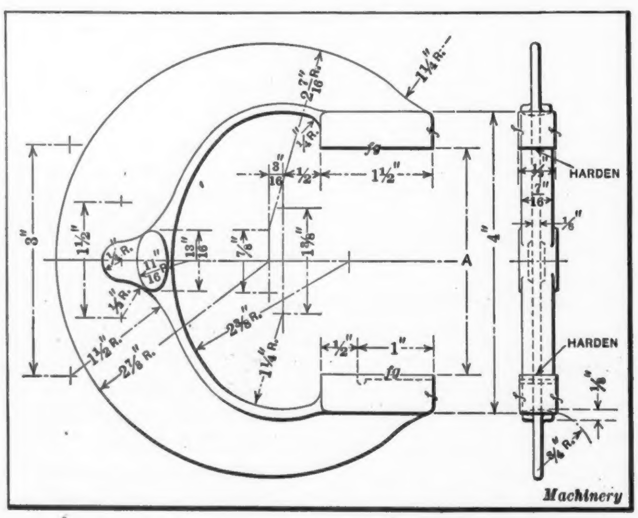


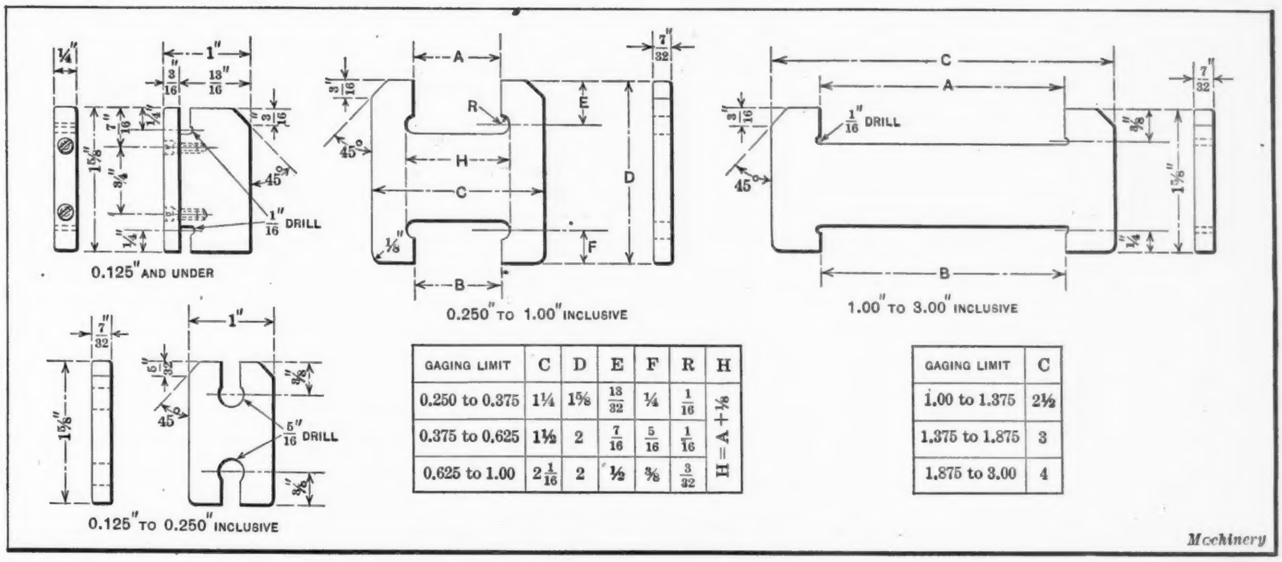
Fig. 3. Standard C-type Snap Gage

The gages shown in Fig. 2 are standard types of two-piece and three-piece construction. The designs *A* and *B* are used for either lengths or diameters from 0 up to and including ⅛ inch. The gage shown at *C* may be used for either lengths or diameters between ⅛ and 1 inch, while at *D* is shown a design that may be used for gaging lengths from 1 to 3 inches.

A "Go" and "Not Go" gage is required for nearly all classes of inspection that involve the use of a snap gage. These gages should be of the plate design and should be made of tool steel, hardened, seasoned, ground, and lapped. The corners of the "Go" end should be chamfered to provide ready recognition. All snap gages, for use on work below ⅛ inch, should be made of two parts so as to facilitate the lapping operation. It is difficult to lap out a very narrow snap gage; the best method has been found to consist of employing a milling machine and a brass lap charged with diamond dust. The following grinding allowances for lapping are recommended:

Opening, Inches	Allowance, Inch
3/16 to 1	0.0002 to 0.0004
1 to 3	0.0004 to 0.0007
3 to 6	0.0007 to 0.001

In Fig. 4 the dimensions for a complete set of double-end single-step snap gages are given in tabular form. These dimensions cover all sizes required in taking measure-



GAGING LIMIT	C	D	E	F	R	H
0.250 to 0.375	1¼	1⅝	13/32	¼	1/16	H = A + ⅛
0.375 to 0.625	1½	2	7/16	5/16	1/16	
0.625 to 1.00	2 1/16	2	½	⅝	3/32	

GAGING LIMIT	C
1.00 to 1.375	2½
1.375 to 1.875	3
1.875 to 3.00	4

Fig. 4. Double-end, Single-step Snap Gages

ments up to and including 3 inches. This type is used for the same purpose as the gages shown in Fig. 5, but is made with the "Go" and "Not Go" gaging surfaces at opposite ends of the gage instead of at one end. There are cases where it would be impossible to use single-ended two-step gages on account of the fact that the first step projects over the work and meets interferences on the work, which would prevent the "Not Go" step from coming in contact with the surface to be gaged. Therefore, by making the "Go" and "Not Go" gaging surfaces on opposite ends of the gage this obstacle is overcome.

In Fig. 5 a set of single-end, double-step, length snap gages is shown, with all the necessary dimensions for making them. Fig. 6 illustrates the design of single-end, double-step snap gages, having a range for gaging diameters from 0 up to and including 3 inches. The single-end, single-step snap gages shown in Fig. 7 are used for measuring maximum or minimum lengths only, and are intended for special cases where a two-step snap gage is not necessary. Single-end, single-step snap gages, such as shown in Fig. 8 are designed for gaging diameters from 0 up to 3 inches. This type is sometimes used in connection with ring gages.

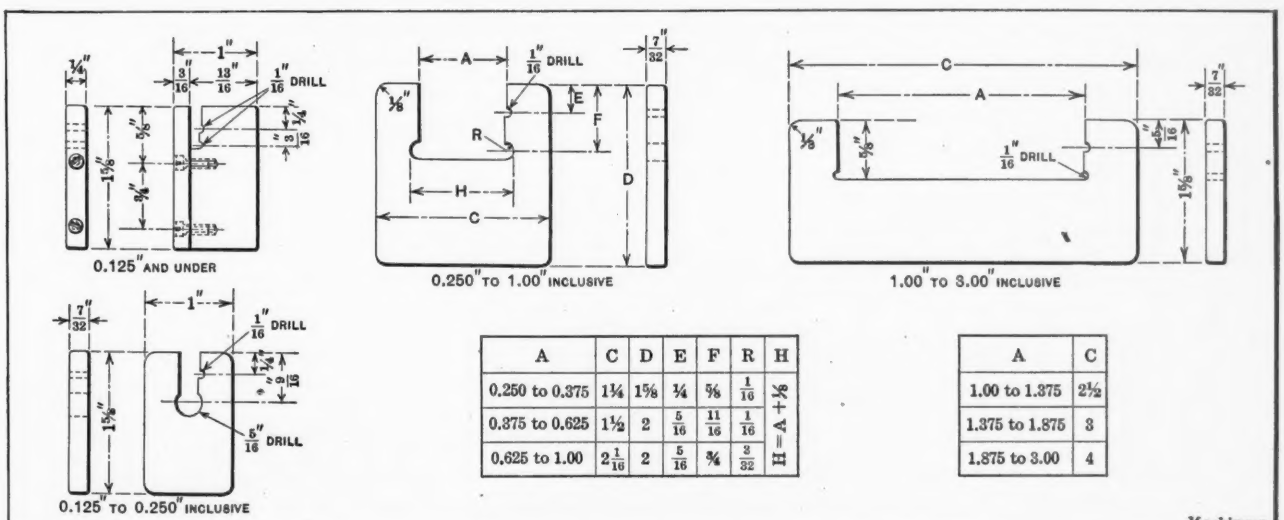
Plug Gage Design

Some standard method of proportioning plug gages such as shown in Table 1, should be established so that all gaging plugs for a given diameter will be uniformly proportioned. Draftsmen have different ideas of the correct proportions to which plugs should be made, and if no standards are established, a large assortment of plugs of various lengths for the same gaging diameter is soon accumulated. As the "Not Go" plugs are not intended to enter the work, they should be quite short, thereby saving material and reducing the cost of manufacture. Plug gages up to and including 2 inches in diameter should be made of hardened tool steel, but the larger sizes may be made of machine steel, pack-hardened.

Operations on Plug Blanks prior to Lapping

The blanks for plug gages should be roughed out and annealed. This practice should always be followed when making large gages, so as to prevent warping or cracking in hardening. The grinding allowance should be from 0.010 to 0.020 inch, or even more, according to the size of the gage. After hardening a plain gage, the measuring end should be drawn until water will boil on it. The handle end may be drawn to a straw color.

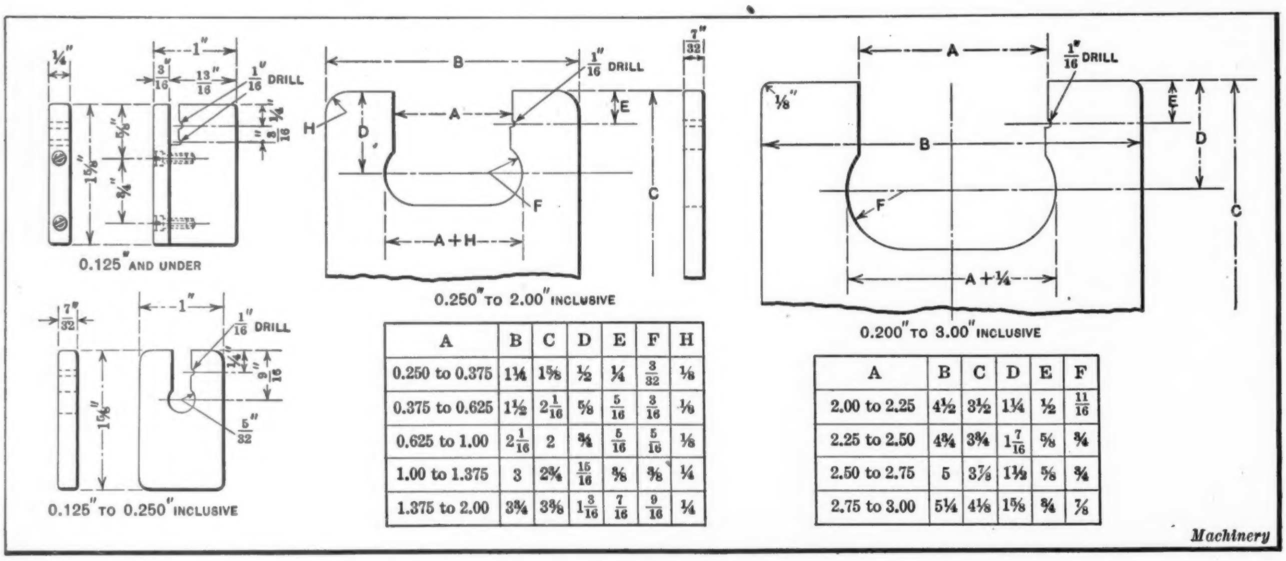
Before grinding, the centers should be thoroughly cleaned. After the work is rough-ground, it should be laid aside and given time to season. The allowance for final grinding should be from 0.003 to 0.006 inch, according to size. When less than 0.002 inch of metal is allowed for finishing, the gages are likely not to "clean up" because of the warping while seasoning. Work which is ready for lapping should also be laid away until actually wanted in order to give it time to swell, which often increases the size 0.0001 or 0.0002 inch. If accurately ground, 0.0002 inch will be enough finish allowance for lapping. After a little experience, the roundness of the work can be judged by the sparks from the wheel. When the work is mottled it is an indication that the wheel is out of balance.



A	C	D	E	F	R	H
0.250 to 0.375	1¼	1⅝	¼	⅝	1/16	H = A + ⅛
0.375 to 0.625	1½	2	5/16	11/16	1/16	
0.625 to 1.00	2 1/16	2	5/16	¾	3/32	

A	C
1.00 to 1.375	2½
1.375 to 1.875	3
1.875 to 3.00	4

Fig. 5. Single-end, Double-step Snap Gages for Lengths



A	B	C	D	E	F	H
0.250 to 0.375	1¼	1⅝	½	¼	3/32	⅛
0.375 to 0.625	1½	2 1/16	⅝	5/16	3/16	⅛
0.625 to 1.00	2 1/16	2	¾	5/16	5/16	⅛
1.00 to 1.375	3	2¾	15/16	⅝	⅜	¼
1.375 to 2.00	3¾	3⅝	1 3/16	7/16	9/16	¼

A	B	C	D	E	F
2.00 to 2.25	4½	3½	1¼	½	11/16
2.25 to 2.50	4¾	3¾	1 7/16	⅝	¾
2.50 to 2.75	5	3⅞	1½	⅝	¾
2.75 to 3.00	5¼	4⅛	1⅝	¾	⅞

Fig. 6. Single-end, Double-step Snap Gages for Diameters

Lapping the Gages

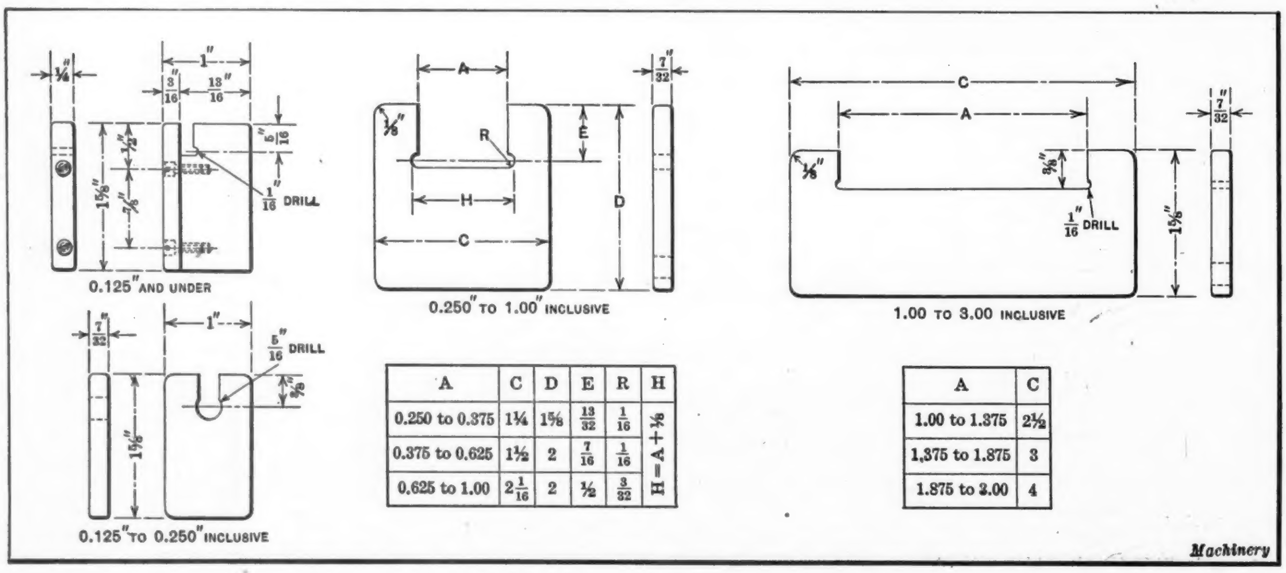
For a lapping compound, washed flour of emery should be used. It may be prepared by mixing one part emery with five parts lard oil in a clean can. After stirring, allow the mixture to stand for about ten minutes and then carefully pour off the oil, which rises to the surface, into another clean can. The emery that is suspended in the oil at the expiration of ten minutes in most cases will be found suitable; however, if a finer abrasive is required, the oil should be allowed to stand longer before pouring it off. If there is a large amount of work to be done and a fine finish is not required, five minutes will be long enough for the emery and oil to stand. Keep the mixture covered while it is not actually in use or when working near a dry grinding machine, as any coarse particles which are deposited in the oil will scratch the gage. A little kerosene used on the lap will prevent it from gumming.

All laps for small work should be made of brass; for large work cast iron should be used. For a gage from 1½ to 2 inches long, a lap about ¾ inch long should be used. Laps should always be shorter than the work. On the average lathe, the slowest speed available with the back-gears out will be found about right for lapping gages of ordinary size. Care should be taken to see that the work does not revolve at too great a speed. The tailstock should be used only for heavy gages, as it prevents the lap from being readily removed.

In performing the lapping operation, the gage is chucked and the sharp corners removed with an oilstone, and then the gage is wiped off lengthwise with a soft cloth, and measured to ascertain the amount of metal that must be removed. The lap is then put on and the tension screws adjusted for a snug fit. If it is found that the work is tapered, it should first be lapped straight. With each revolution of the work, the lap should be moved about ¾ inch axially back or forth. If the lap is properly tightened and is moved rapidly from place to place, the highest points will be taken off first. This does not occur, however, when the speed of the work is too high, when the lap is loose, or when it is moved leisurely at a rate of about 1/16 inch per turn of the work.

Care should be taken not to lap too much near the end of the gage. About five or six times back or forth up to within ⅛ inch of the end, to each time over the end, is about right. The reason for not lapping the end as much as the rest of the gage, is to avoid tapering it; this may also be caused if the lap is not removed quickly. The removal of the lap will usually reduce the end of the gage sufficiently, even if it has not previously been lapped off as much as the rest of the gage. It does not require so much skill to remove the first 0.0001 or 0.00015 inch as it does to remove the last 0.00005 inch. The man who does light gage lapping should not do heavy lapping, as it destroys the delicate touch necessary for the former class of work. For removing spots which sometimes project above the surface of the gage, a narrow lap about ¼ inch wide should be used.

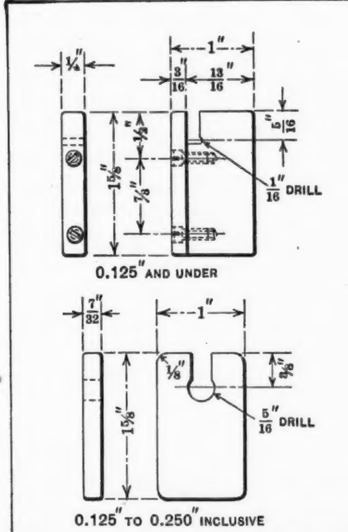
In order to produce a high finish on the gage, the lap is dried; the gage which is being lapped is allowed to dry for a few moments before dry-lapping to produce the desired

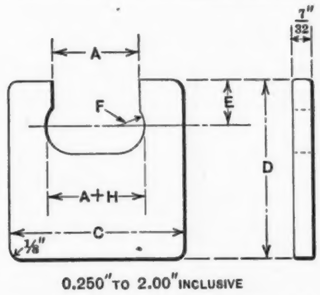


A	C	D	E	R	H
0.250 to 0.375	1¼	1⅝	13/32	1/16	H = A + ⅛
0.375 to 0.625	1½	2	7/16	1/16	
0.625 to 1.00	2 1/16	2	½	3/32	

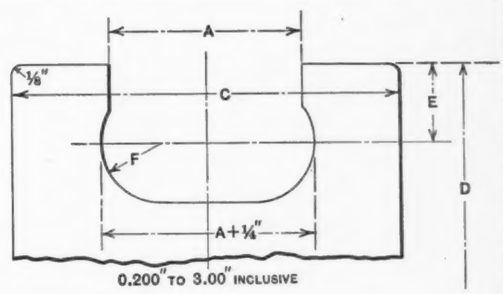
A	C
1.00 to 1.375	2½
1.375 to 1.875	3
1.875 to 3.00	4

Fig. 7. Single-end, Single-step Snap Gages for Lengths





A	C	D	E	F	H
0.250 to 0.375	1¼	1⅝	$\frac{5}{16}$	$\frac{3}{32}$	⅛
0.375 to 0.625	1½	2$\frac{1}{16}$	⅜	$\frac{3}{16}$	⅛
0.625 to 1.00	2$\frac{1}{16}$	2	½	$\frac{5}{16}$	⅛
1.00 to 1.375	3	2¾	¾	⅝	¼
1.375 to 2.00	3¾	3⅜	⅞	$\frac{9}{16}$	¼



A	C	D	E	F
2.00 to 2.25	4½	3⅛	⅞	$\frac{11}{16}$
2.25 to 2.50	4¾	3¼	$\frac{15}{16}$	¾
2.50 to 2.75	5	3⅜	1	¾
2.75 to 3.00	5¼	3½	1	⅞

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Fig. 8. Single-end, Single-step Snap Gages for Diameters

finish. When doing this, care should be taken to have the lap a tight fit and to lap quickly, going back and forth rapidly over the gage; otherwise the lap is likely to score the work. A high polish may also be obtained by using machine oil when only about 0.00005 inch of metal remains to be lapped. The sharp corners should finally be slightly stoned off.

Although gages are usually made of tool steel, good results may be had with machine steel, pack-hardened; and if properly carburized, these gages will last longer than tool steel gages, although they are likely to show soft spots here and there. Pack-hardened gages act somewhat like high-speed steel on the grinding wheel, and also require more time for lapping to size.

Plug Gage Handles

Plug gage handles are an important item, and should be made up in standard sizes. Handles may be made round and knurled, or they may be made from hexagon bar stock. If round handles are preferred, there should be a flat milled on one side, or a plain band turned to provide a place for stamping identification numbers or initials. In Table 2 are given the dimensions for a complete set of removable hexagon handles for plugs up to 2 inches in diameter. Handles should be made of either machine or cold-rolled steel and should be left soft.

Standard Ring Gages

Ring gages are used for measuring external diameters of work. They are made up in standard sizes which are available in the market, but special sizes are usually made by the manufacturer in his own tool-room. Table 3 gives all the dimensions for a complete set of standard blanks for measuring diameters up to 6 inches. For diameters larger than 6 inches it is best to use snap gages entirely, as they are not so heavy.

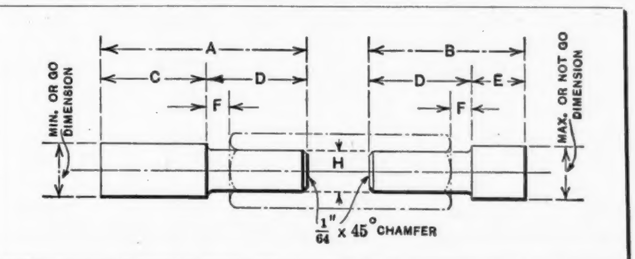
Ring gages are sometimes used in conjunction with snap gages, a minimum snap gage being used with a maximum ring gage. This practice is advisable on work larger than ¾ inch in diameter. It is evident that a workman could easily force a snap gage over work which is so much out of round or eccentric that it would not permit a maximum ring gage to pass over it. With this system, the ring is used as a check on the minimum snap. This method represents very good practice for gaging diameters.

Rings for gaging work up to ½ inch should be made to fit a standard plate-holder such as shown in Fig. 9. Such a holder should be made of a convenient size to fit the hand and will keep both the "Go" and "Not Go" rings together and convenient for use. Ring gages should be made from a grade of tool steel containing not less than 1 per cent carbon—hardened, seasoned, ground, and lapped. The maximum or "Go" ring gage should be distinguished from the minimum or "Not Go" gage by a pronounced chamfer on the outside diameter. The outside diameters of both rings should be knurled.

Making Ring Gages

In making ring gages, great care should be taken to clamp the work lightly when grinding the hole. When gripped in the chucks, one should be able to remove the gage from the

TABLE 1. DIMENSIONS OF PLUG GAGE BLANKS



Diam. of Plug	A	B	C	D	E	F	H
0 to 0.125	$\frac{15}{16}$	¾	$\frac{7}{16}$	½	¼	⅛	⅛
0.125 to 0.250	1$\frac{3}{16}$	$\frac{15}{16}$	½	$\frac{11}{16}$	¼	⅛	$\frac{5}{32}$
0.250 to 0.375	1⅝	1$\frac{3}{16}$	$\frac{13}{16}$	$\frac{13}{16}$	⅜	$\frac{3}{16}$	¼
0.375 to 0.500	2	1½	1	1	½	$\frac{3}{16}$	$\frac{5}{16}$
0.500 to 0.625	2$\frac{7}{16}$	1$\frac{13}{16}$	1¼	1$\frac{3}{16}$	⅝	¼	$\frac{7}{16}$
0.625 to 1.00	2$\frac{15}{16}$	2¼	1$\frac{7}{16}$	1½	¾	¼	½
1.00 to 2.00	2⅞	2⅜	1¼	1⅝	¾	¼	⅝

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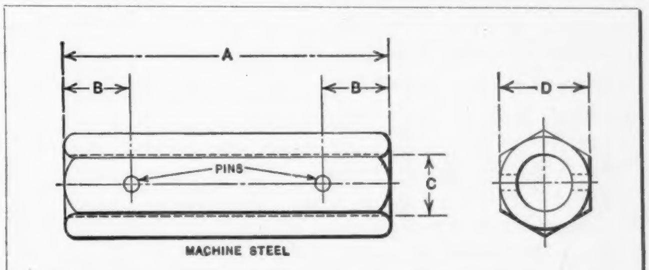
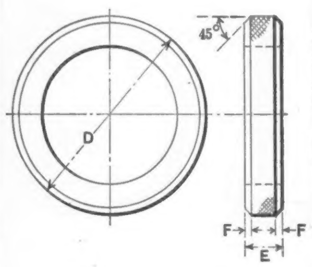
TABLE 2. PLUG GAGE HANDLE DIMENSIONS



Use for Plugs Diam. from	A	B	C	D	Pins
0 to 0.125	1$\frac{5}{16}$	$\frac{7}{32}$	⅛	¼	$\frac{1}{16}$ × ¼
0.125 to 0.250	1½	¼	$\frac{5}{32}$	$\frac{5}{16}$	$\frac{1}{16}$ × $\frac{5}{16}$
0.250 to 0.375	1⅞	⅜	¼	$\frac{7}{16}$	$\frac{3}{32}$ × $\frac{7}{16}$
0.375 to 0.500	2¼	$\frac{7}{16}$	$\frac{5}{16}$	$\frac{9}{16}$	$\frac{3}{32}$ × $\frac{9}{16}$
0.500 to 0.625	2⅝	½	$\frac{7}{16}$	$\frac{11}{16}$	$\frac{3}{32}$ × $\frac{11}{16}$
0.625 to 1.00	3	⅝	½	$\frac{13}{16}$	⅛ × $\frac{13}{16}$
1.00 to 2.00	3⅜	$\frac{11}{16}$	⅝	1	⅛ × 1

Machinery

TABLE 3. RING GAGE BLANK DIMENSIONS



For Work	D	E	F
Under 0.750	$1\frac{1}{2}$	$\frac{5}{8}$	$\frac{1}{8}$
0.75 to 1.00	2	$\frac{5}{8}$	$\frac{1}{8}$
1.00 to 1.50	$2\frac{3}{4}$	$\frac{3}{4}$	$\frac{1}{8}$
1.50 to 2.00	$3\frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{8}$
2.00 to 2.50	4	$\frac{3}{4}$	$\frac{1}{8}$
2.50 to 3.00	$4\frac{1}{2}$	$\frac{7}{8}$	$\frac{3}{16}$
3.00 to 3.50	$5\frac{1}{4}$	$\frac{7}{8}$	$\frac{3}{16}$
3.50 to 4.00	6	1	$\frac{3}{16}$
4.00 to 4.50	$6\frac{1}{2}$	1	$\frac{3}{16}$
4.50 to 5.00	7	1	$\frac{3}{16}$
5.00 to 5.50	8	$1\frac{1}{8}$	$\frac{1}{4}$
5.50 to 6.00	$8\frac{1}{2}$	$1\frac{1}{8}$	$\frac{1}{4}$

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chuck by hand. Plenty of material should be left for lapping, as ring gages have a tendency to become misshapen after a few weeks' seasoning, or to become out of round owing to soft spots. The lapping allowance for ring gages should be 0.001 inch for work from ¼ to 1 inch in diameter; 0.0015 inch for work from 1 to 2 inches in diameter; and 0.002 to 0.003 inch for work from 2 to 3 inches in diameter. No lapping allowance is necessary for small gages for use on work under ¼ inch in diameter, as these gages can be lapped directly to size immediately after hardening.

The material for laps for small ring gages should be brass, but for large gages cast iron is preferable. The cast-iron arbor bushings which are used in lapping are reamed with a standard taper pin reamer, ¼ inch taper per foot. One end of the arbor is made straight so that it may be securely held in the chuck. The arbors may be either hardened and ground all over, or if preferred the ends only may be hardened to preserve the centers. The tailstock center support is required only on large work. The lap should be bored or reamed, split lengthwise, and then driven onto the arbor tight enough to hold while it is being turned on the outside. This type of lap does not need a key to prevent it from turning on the arbor, as is the case with lead laps. On round work, lead laps are not to be recommended, as they lose their shape too easily when driven on the arbor or when a sharp corner of the work catches in the lead. A further objection is that they lack the necessary elasticity to hold them securely on the arbor when driven on. Ordinary cast iron will be found suitable for laps, and if made from such material they will hold their shape for a long time. Laps about ¼ inch in diameter will give better results when grooved, but the grooves should not extend to the end. The grooves can be filed in the lap or holes may be spotted as a means of keeping the emery on the surface of the lap. The ends of the lap should be reduced for about ⅛ inch, and the corners rounded to prevent raising a burr when driving or pressing it on the arbor. A piece of copper should be used when driving laps on or off the arbors.

Tolerances as Applied to Gage Making

The tolerances given in Table 4 are for plain gages, and are applied in such a manner that the tolerances permitted on the gage are included in the manufacturing tolerance allowed on the work. This insures that any work passed by the gages will be within the tolerance specified on the drawing. The tolerances given also permit the classification and selection of gages, so that if a gage is not suitable for a master gage it may be classified and used as an inspection gage or working gage, according to the tolerance it is found to have by actual measurement.

Examples of the application of tolerances for master inspection and working gages will be given in connection with the gage diagram Fig. 10 and Table 4. These examples cover all conditions except those for what may be termed special gages. In order to thoroughly understand the system, it will be well to take as an example a simple single-end, double-step snap gage, such as illustrated in Fig. 10, and furnish a complete explanation of the method of applying the tolerances.

Starting with the basic dimension 1.250 $\begin{smallmatrix}+0.000\\-0.005\end{smallmatrix}$ and referring to Table 4, the gage tolerance allowed on the gage may be found. The tolerance on the work governs all tolerances on the gages, and since tolerance means the total difference between the maximum and minimum dimensions of the work, the total limit allowed on the work must be used to determine the gage tolerance. In this case the total work allowance is 0.005 inch, (if the allowance read $\begin{smallmatrix}+0.005\\-0.005\end{smallmatrix}$ inch, the tolerance would be 0.010 inch). Referring to the table, the value 0.005 is found (included in the space 0.004 to 0.006), and directly opposite under "master gages" in the column for "Not Go" male and "Go" female gages, is found the "Not Go" gage tolerance of $\begin{smallmatrix}+0.0000\\-0.0003\end{smallmatrix}$. In the same manner, the gage tolerance on the inspection and working gage units may be found. The basic maximum dimension is 1.250 inches and the basic minimum dimension is 1.250 minus 0.005 or 1.245 inches. These two values are basic "Go" and "Not Go" dimensions for each gage as will be noted from the diagram in Fig. 10, and the gage tolerances only change in each gage. The inspection and working gages are not made to the basic figures 1.250 and 1.245, but to the basic figures plus or minus the tolerances given. For example, the "Go" end of the inspection gage is 1.2497 (maximum) and 1.2494 (minimum), and these two dimensions are the actual working figures for the toolmaker. The dimensions for the working gage are also computed in like manner, and no confusion should be experienced in applying this system.

TABLE 4. TOTAL MANUFACTURING TOLERANCES ON PLAIN GAGES

Tolerance on Work	Master Gages		Inspection Gages		Working Gages	
	"Go" Male and "Not Go" Female Gages	"Not Go" Male and "Go" Female Gages	"Go" Male and "Not Go" Female Gages	"Not Go" Male and "Go" Female Gages	"Go" Male and "Not Go" Female Gages	"Not Go" Male and "Go" Female Gages
0.000 to 0.002	− 0.0000 + 0.0001	+ 0.0000 − 0.0001	+ 0.0001 + 0.0003	− 0.0001 − 0.0003	+ 0.0003 + 0.0005	− 0.0003 − 0.0005
0.002 to 0.004	− 0.0000 + 0.0002	+ 0.0000 − 0.0002	+ 0.0002 + 0.0004	− 0.0002 − 0.0004	+ 0.0004 + 0.0007	− 0.0004 − 0.0007
0.004 to 0.006	− 0.0000 + 0.0003	+ 0.0000 − 0.0003	+ 0.0003 + 0.0006	− 0.0003 − 0.0006	+ 0.0006 + 0.0010	− 0.0006 − 0.0010
0.006 to 0.010	− 0.0000 + 0.0004	+ 0.0000 − 0.0004	+ 0.0004 + 0.0009	− 0.0004 − 0.0009	+ 0.0009 + 0.0015	− 0.0009 − 0.0015
0.010 to 0.020	− 0.0000 + 0.0006	+ 0.0000 − 0.0006	+ 0.0006 + 0.0014	− 0.0006 − 0.0014	+ 0.0014 + 0.0025	− 0.0014 − 0.0025
0.020 to 0.050	− 0.0000 + 0.0008	+ 0.0000 − 0.0008	+ 0.0008 + 0.0020	− 0.0008 − 0.0020	+ 0.0020 + 0.0035	− 0.0020 − 0.0035
0.050 and over	− 0.0000 + 0.0010	+ 0.0000 − 0.0010	+ 0.0010 + 0.0025	− 0.0010 − 0.0025	+ 0.0025 + 0.0050	− 0.0025 − 0.0050

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It is very good practice to give on the gage drawings the actual figures desired and not the basic figure plus or minus the tolerance, as this causes the toolmaker to add or subtract the tolerance as the case may be, in order to find the actual dimensions and the limit allowed on the gage. This offers a chance for a mistake to be made which may not be discovered until the gage reaches the tool inspection department (unless the gage were inspected after each operation). Such possibilities for mistakes could be obviated if the *actual* figures were placed on the drawing in the first place. On the master gages, the above suggestion does not apply, as in this case there is a limit in one direction only, such as $^{+\,0.0005}_{-\,0.0000}$ or $^{+\,0.0000}_{-\,0.0005}$ and the toolmaker can readily see what is required.

The application of the tolerance for plain master, inspection, and working gages is such that the tolerance for the gages is included in the tolerance allowed on the work.

Examples of Tolerance Application—Master Gages

The following examples apply directly to master gages, which are of the same design and construction as the working or inspection gages. If it is required to gage a cylinder having an outside diameter $1.250\,^{-\,0.005}_{+\,0.000}$ the master gages, whether they be snap, ring or other gages that have inside gaging dimensions, should have the following limits:

"Go" Gage—Dimension of the "Go" or maximum master female gage, $1.250\,^{+\,0.0000}_{-\,0.0003}$

"Not Go" Gage—Dimension of the "Not Go" or minimum master female gage, $1.245\,^{-\,0.0000}_{+\,0.0003}$

If it is required to gage an internal diameter having a dimension of $1.260\,^{-\,0.000}_{+\,0.005}$ the master plug gages and the other gages that have plain outside gaging dimensions should have limits as follows:

"Go" Gage—Dimension of the "Go" or minimum master male gage, $1.260\,^{-\,0.0000}_{+\,0.0003}$

"Not Go" Gage—Dimension of the "Not Go" or maximum master male gage, $1.265\,^{+\,0.0000}_{-\,0.0003}$

Examples of Tolerance Application—Inspection Gages

New inspection gages will be required to be within the limit of tolerances as shown in Table 4. They are to be discarded when they reach the limit established either by the part drawing or by the master inspection gages which are the physical standards for the limits established by the part drawing.

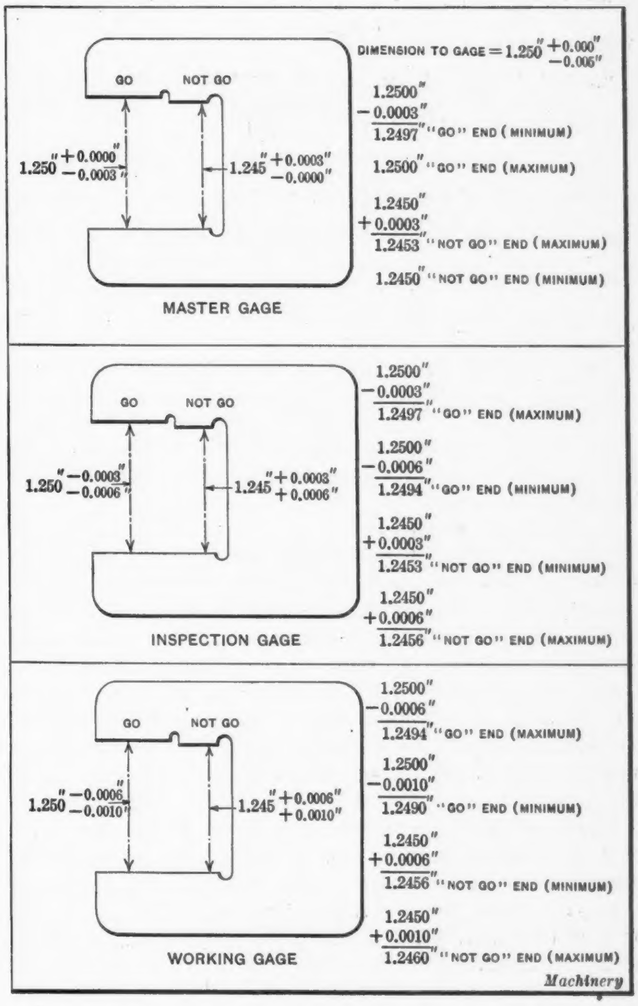


Fig. 10. Master, Inspection, and Working Snap Gages showing Gage Tolerance System

If it is required to gage a cylinder having an outside dimension $1.250\,^{+\,0.000}_{-\,0.005}$ the inspection snap, ring or other equivalent gages that have inside gaging dimensions, should have limits as follows:

"Go" Gage—Dimension of the "Go" or maximum inspection female gage, $1.250\,^{-\,0.0003}_{-\,0.0006}$

"Not Go" Gage—Dimension of the "Not Go" or minimum inspection female gage, $1.245\,^{+\,0.0003}_{+\,0.0006}$

If it is required to gage an internal diameter having a dimension of $1.260\,^{-\,0.000}_{+\,0.005}$ the inspection plug gages or other gages that have plain outside gaging dimensions should have the following limits:

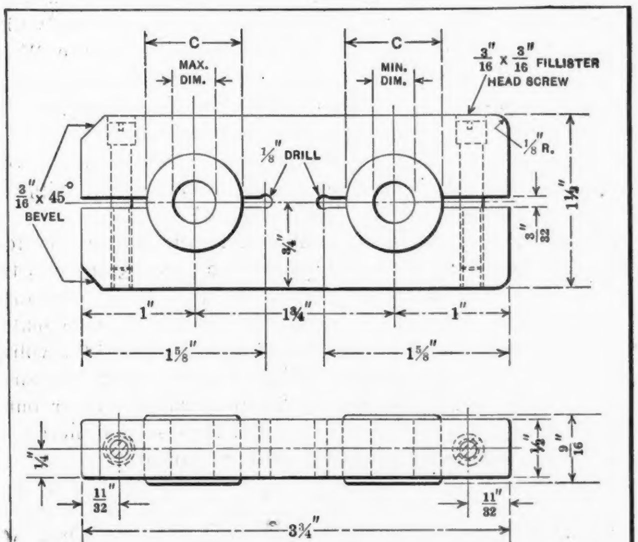
"Go" Gage—Dimension of the "Go" or minimum inspection male gage, $1.260\,^{+\,0.0003}_{+\,0.0006}$

"Not Go" Gage—Dimension of the "Not Go" or maximum inspection male gage, $1.265\,^{-\,0.0003}_{-\,0.0006}$

Examples of Tolerance Application—Working Gages

The application of the tolerances for working gages will be explained by the following examples:

If it is required to gage a cylinder having an outside dimension $1.250\,^{+\,0.000}_{-\,0.005}$ the working snap, ring, or other equivalent gages that have inside gaging dimensions, should have limits as follows:



RING SIZES	C	RING SIZES	C
UNDER 0.125	5/8	0.250 TO 0.375	7/8
0.125 TO 0.250	3/4	0.375 TO 0.500	1

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Fig. 9. Standard Plate-holders for Ring Gages

"Go" Gage—Dimension of the "Go" or maximum female working gage, 1.250 $\begin{matrix}-0.0006\\-0.0010\end{matrix}$

"Not Go" Gage—Dimension of the "Not Go" or minimum female working gage, 1.245 $\begin{matrix}+0.0006\\+0.0010\end{matrix}$.

If it is required to gage an internal diameter having a dimension of 1.260 $\begin{matrix}-0.000\\+0.005\end{matrix}$, the working plug gages or other gages that have plain outside gaging dimensions should be made to the following limits:

"Go" Gage—Dimension of the "Go" or minimum male working gage, 1.260 $\begin{matrix}+0.0006\\+0.0010\end{matrix}$

"Not Go" Gage—Dimension of the "Not Go" or maximum male working gage, 1.265 $\begin{matrix}-0.0006\\-0.0010\end{matrix}$

The use of the tolerances suggested for working gages will insure that all parts passing the working gages will pass the inspection gages.

By using this system, female gages are added to the working gage stock when the inspection gages become worn; and when male working gages are reduced by wear so that the inspection gage will not pass the work, these gages are placed in the stock of inspection gages. As inspection male gages become worn below the limit, they should be taken out of the gaging system entirely and either scrapped or inspected for tolerance, and if found correct for master gages, should be used as such. This classification is done in the tool inspection department, where the actual measurement of the gages takes place.

A good general rule to apply for the exact location of the plus or minus tolerances and a rule which applies to the tolerance system in Table 4 and is applicable on special gages, etc., is as follows: A minimum gage has a maximum or plus tolerance, while a maximum gage has a minimum or minus tolerance.

* * *

THE IMPORTANCE OF CAREFUL DETAIL WORK

BY WARFIELD WEBB

Anyone can do ordinary work, but to excel in whatever you undertake is made possible only by recognizing the fact that in connection with your work there is nothing that is not worthy of your consideration. Many fail to achieve the greatest success of which they are capable because they leave to others what they consider to be trivial things, or do not have these small details attended to at all. In engineering, especially, this is a dangerous thing. Many of the greatest achievements in the world of science and engineering have been arrived at by inventors and discoverers who did not overlook trivial details. Had they done so, or had they relegated these details to the care of others, the work that they did would have been left for others to accomplish.

In order to be able to distinguish between details that are of importance and those that are not, judgment is required. This judgment comes largely by the mastery of detail. To one who has become thoroughly familiar with all the details in his line of work, it is easy to distinguish between the important and the non-essential matters, but to attain this judgment and experience takes time; and it is best at all times not to be too sure in overlooking small matters. It is the painstaking care with details and the judgment to distinguish between essentials and non-essentials that most clearly distinguishes the executive from the routine man.

To master details requires concentration and willingness to work. It demands a given amount of energy and a certain amount of labor. Most men are not willing to give this additional amount of labor to their tasks, but are content with their present situation and do not aim to rise higher. They are willing to let the other man move forward. This is one reason why there are so few men who have mastered the difficult details that bring with them a chance for promotion.

ECONOMIC CONDITIONS IN RUSSIA

The Commerce Reports, issued by the Bureau of Foreign and Domestic Commerce, Washington, D. C., recently published a translation from the July 18 number of *Mercator*, a Finnish trade journal, dealing exhaustively with the present economic conditions in Russia. From this article, it appears that most of the industries are being nationalized, so that they are directly controlled by the state, and there is a considerable modification of the power of the labor unions with regard to management. The government has deprived the industrial workers of their right to have any influence on the technical side of work-shop management, and the intention is to prevent any direct influence by the workers in the management of industrial enterprises. Piecework and premium-payment systems have also been introduced in many of the factories that are managed directly by the government. It is apparent from present indications that the tendency in Russia is toward direct state control of all industrial enterprises, the workers having power to influence the management only through their regular voting power as citizens of the state.

With this return to what might be considered more conservative methods of management goes, however, the radical campaign against private property. Several textile mills, until recently independent, have been taken over by the national government and the nationalization is being extended to as many industries as possible. The financial conditions appear to be as yet very unsatisfactory. There is a great deal of paper money in circulation that is almost valueless, and there are so many issues of different kinds of paper money that it is difficult to determine the exact amount of currency in circulation. Some of the large cities are now issuing money. In Odessa, for example, there are three kinds of rubles in circulation issued by the national governments—the Czar, the Duma, and the Kerensky rubles; then there is the currency of the Don Republic, the currency of the municipality of Odessa, and another Odessa currency based on a diamond standard. This indicates the difficulty of doing business with Russia at the present time.

From another source it has been learned that trade carried on between Sweden and Russia takes place entirely on an exchange basis. Swedish merchants will load a ship with necessities required in Russia and will take in exchange in the Russian harbor such goods as have been stored there with a view to exchanging with foreign shippers. No money is handled in the transaction, and no credit is given or asked.

The British Department of Overseas Trade has submitted a proposition for supporting important British trade with Russia. It is the intention, in conjunction with the War Risks Office, to arrange for marine and other war insurance on goods between England and Russia, and to insure British goods from the time they are unloaded until they are sold, and Russian goods from their place of purchase to shipboard in Russian harbor. The great risk on merchandise shipped to and from Russia would thus be covered.

According to a statement published in the Commerce Reports, England considers it necessary to make great efforts to enter the Russian market, because otherwise Germany may dominate in Russia, especially if political developments go in the direction of a coalition of the interests of revolutionary Russia and Germany. Without a merchant fleet and without any connections among the western powers or outside of Europe, there is only one outlet for German energy—over the land boundaries to the eastern markets.

* * *

Speculum metal is the technical name for the alloy of which telescope mirrors or reflectors are made. Its composition is two parts copper and one part tin. The addition of 1 or 2 per cent metallic arsenic gives the metal a greater compactness and a greater luster and hardness, but if such addition is made, the metal is likely to tarnish. The metal is very hard and as brittle as sealing wax.

The Machine Tool Trade

THERE has been no appreciable change in the situation in the machine tool trade during the past month, practically all manufacturers reporting a satisfactory business and many having orders so far ahead that they quote on deliveries well into 1920. Other machine-building industries also seem to be quite active, and this, of course, has a satisfactory effect upon the machine tool trade. The activity on the part of a number of other industries is well indicated by the business of the gear manufacturers who, throughout the country, appear to have their factories well employed. In addition to the well-known activity in the automobile and accessory field, the manufacture of textile machinery appears to be very active; many of the textile mills have built large additions or are contemplating expansion. The machine tool builders who depend largely upon the railways as customers find business quiet, however, except in some special lines; the railways, as is generally known, are not in a position to buy at the present time on account of the policy pursued by the federal railway administration.

There have been local labor disturbances in several places in the machine tool trade, but these appear now to have been settled, the men having gone back to work under the old conditions. The steel strike, of course, has had its influence upon the machine tool trade, and there has been less buying since the beginning of the labor disturbances in the steel field.

In the case of heavy special machinery, there has been a decided reduction in prices since the armistice, and what appears to be ill-advised competition leaves little chance for remunerative business, many plants apparently figuring on prices that will merely keep their organizations together and thereby forcing others to quote equally low. This, however, does not refer to the machine tool line, but to special lines of heavy punching machinery, large shears, hydraulic presses, etc., on which there is comparatively little machining work, and where most of the expense involved is for castings and other material.

In the machine tool field, again, some prices have been increased, because of the continued increase in manufacturing costs. It is not apparent that the machines sold by the Government have appreciably affected the market, although they are now beginning to be sold in increasing quantities. The dealers may feel this competition to some extent, but nearly all the manufacturers quote on deliveries so far ahead that no immediate difficulty is caused by the placing of the government-owned machinery on the market.

Cranes are being sold at prices about 35 per cent below those of a year ago, but as materials are a large item in crane construction, and as there has been a cut of about 25 per cent in materials, this accounts, to some extent, for the reduced prices of cranes. There have been statements made to the effect that prices in this line are likely to be advanced before long.

The shortage of unskilled labor is making itself felt more and more. This is the case especially in foundry work where a considerable proportion of unskilled help is required. It is stated by the American Malleable Castings Association that at the present time fully 200,000 tons of malleable foundry capacity is idle because the necessary labor cannot be secured. Improvement in this direction, it is stated, is not to be expected until there is a flow of immigration sufficient to build up the supply of labor required for foundry work.

Foreign Trade Conditions

Owing to the abnormal conditions of foreign exchange, the export machine tool trade has suffered during the last few months. There is still a considerable amount of foreign trade, however, and advices from France from actual buyers of machine tools indicate that they would still be in the market for American machine tools, at present prices, if the dealers had machines in stock for immediate delivery. The last report of exports of metal-working machinery from the United States, issued by the Department of Commerce, covers the month of August. This report, given in detail in the accompanying table, shows that the value of machine tools exported amounted to slightly over $2,000,000, of which lathes of various kinds represented $775,000. England continues as the biggest customer, having imported metal-working machinery during the month of August to the sum of nearly $1,000,000, of which over $600,000 represented the value of machine tools. The exports to France in metal-working machinery amounted to, nearly $800,000, of which about one half represented machine tools. The total exports of machine tools to Japan amounted to about $130,000; to Canada, $115,000; and to Belgium, $110,000; while, in each case, a much larger amount of other metal-working machinery was also exported.

EXPORTS OF METAL-WORKING MACHINERY FROM THE UNITED STATES, AUGUST, 1919

Countries	Lathes	Sharpening and Grinding Machines	Other Machine Tools	All Other Metal Working Machinery
	Dollars	Dollars	Dollars	Dollars
Belgium	45,213	60,802	3,276	132,960
Denmark	468	10,149	26,381	12,754
Finland	1,900	......	1,592	10,060
France	118,536	65,985	207,829	393,208
Greece	......	......	261	......
Italy	264	......	40,562	17,405
Netherlands	27,148	1,998	12,820	5,409
Norway	2,288	1,490	8,587	12,228
Portugal	16	4	924	6,993
Russia in Europe	......	......	57,000	......
Spain	19,550	6,107	19,425	56,894
Sweden	13,625	6,867	2,442	22,238
England	327,519	58,252	244,835	341,238
Scotland	......	6	66,675	5,179
Ireland	......	82	......	......
Canada	27,652	18,282	69,867	271,521
Guatemala	......	26	162	65
Nicaragua	......	......	43	......
Panama	......	......	258	1,263
Mexico	498	6,537	2,834	924
Newfoundland and Labrador	......	41	......	551
Jamaica	......	25	105	480
Other British West Indies	......	......	161	25
Cuba	31,845	6,309	34,815	16,225
Haiti	1,320	11	......	......
Dominican Republic	590	114	5,421	1,738
Argentina	2,202	2,998	6,533	9,076
Bolivia	......	......	......	169
Brazil	10,000	2,415	7,153	10,765
Chile	4,740	220	1,443	4,388
Colombia	4,958	......	102	4,030
Ecuador	......	56	217	488
Dutch Guiana	......	......	23	364
Paraguay	......	315	......	......
Peru	3,510	161	1,584	4,286
Uruguay	718	85	1,063	......
Venezuela	......	......	184	......
China	10,075	481	895	7,016
British India	5,980	3,617	13,252	137,588
Straits Settlements	2,125	12	1,612	......
Other British East Indies	......	3,189	......	......
Dutch East Indies	21,688	3,395	5,990	5,684
Hongkong	75	55	750	......
Japan	69,952	19,832	40,594	302,009
Russia in Asia	......	......	160	1,400
Siam	......	......	600	......
Turkey in Asia	......	......	......	1,252
Australia	13,237	22,166	9,259	15,078
New Zealand	3,077	693	2,462	803
French Oceania	172	45	......	......
Philippine Islands	1,363	802	6,829	16,311
Belgian Congo	......	......	......	1,890
British West Africa	33	......	......	......
British South Africa	3,075	11,265	7,908	11,296
French Africa	......	63	90	......
Portuguese Africa	......	35	288	......
Egypt	14	......	203	......
Total	775,434	314,987	915,469	1,843,253

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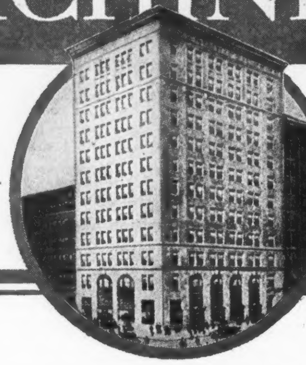

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This issue of MACHINERY is published and mailed at Cleveland, Ohio, as labor demands have enforced the closing of our printing plant for a month.

Everyone who is familiar with the mechanical work on a periodical of this size will appreciate the difficulty of producing it at such a distance from the publication office; and for any deficiencies caused by these conditions we ask the indulgence of our readers and advertisers.

* * *

CAUSES OF INDUSTRIAL UNREST

The following general causes of the present industrial unrest in Great Britain are given by Sir Robert Horne of the British Ministry of Labor: The long strain of the war; the nervous effect produced by the extreme industrial effort of the nation; the disturbance of normal economic life; the rise in the cost of living; and the absorption into Anglo-Saxon thinking of revolutionary ideas from the European continent.

Generally speaking, the same causes are at the bottom of the industrial unrest in the United States. The disturbance of the normal economic life of the nation by the war naturally had to produce a pronounced effect, and the rise in the cost of living is doubtless the greatest single factor in creating and prolonging the present industrial conditions. It is at least the most obvious and direct of many causes and furnishes the readiest reason for labor disturbances.

The unsettling influences that have come from Europe, and particularly from Russia, should not be overlooked. A large section of old Russia is passing through a political and economic experiment, the failure of which seems imminent. But no matter what the outcome may be in Russia, it is certain that there is no need of any similar experiment in the United States, where every man has (and every woman probably soon will have) through the ballot box, the right and the power to effectively express his political and economic views and wishes, and through his chosen representatives to get them established as part of our institutions—provided only that a majority of his fellow citizens agree with him.

The present economic condition is simply a circle—vicious or otherwise, according to the viewpoint of the observer. The wages of labor are constantly being increased, and as a direct result, the cost of living goes up; then the cost of living having gone up, labor demands greater wages. Apparently, the problem is being attacked entirely from the wrong end. There is but one thing that can reduce the cost of living permanently. That is *increased production.*

* * *

PRACTICAL APPLICATION OF THE TOLERANCE SYSTEM

The old saying that a little knowledge is a dangerous thing could hardly be better exemplified than by the present application of the tolerance system in many shops. Engineers and draftsmen who have worked in the highly organized shops where limits are placed on all drawings, are often eager to introduce the same system in smaller plants where they later may have found employment. But to install a system of limits and tolerances and to place these tolerances upon the drawings properly is by no means an easy task, and the first idea or plan—to put limits on every dimension—will lead to many difficulties and will prove costly in the manufacture of the parts.

The pitfalls into which the designer and draftsman may stumble when applying the limit system and dimensioning drawings in accordance with this system, are pointed out in the article by Earle Buckingham, beginning on page 259 of this number of MACHINERY. At first sight it appears to most mechanical men a simple matter to place limits upon drawings, at least after the proper tolerances have been determined in a general way with reference to the conditions that must be met. But to properly dimension a drawing, even though the important facts relating to the tolerance on the work are known, is by no means an easy task.

The war accelerated the introduction of the system of placing limits on drawings; but the methods by which a great many drawings are now being dimensioned are such that the requirements cannot be met in actual commercial work. When limits are placed on every dimension, it is, in many cases, impossible to keep the work within the tolerance without extreme refinement of the work. Tolerances should be placed upon the vital dimensions only; that is, those dimensions that definitely must be between certain predetermined limits. The other dimensions will then practically take care of themselves. This is a general statement, and to understand its full significance, Mr. Buckingham's article must be studied with considerable care. The subject is not one that is easily understood and mastered, and to comprehend its intricacies fully, the principles involved must be given careful thought.

* * *

AMERICAN ENGINEERING STANDARDS

More than fifty engineers, representing practically every organization interested in the development of standards, attended the first meeting of the American Engineering Standards Committee held at the Engineers' Club in New York City in September. Charles LeMaistre, secretary of the British Engineering Standards Association, was the guest of the American committee. The British association, which was formed in 1901 and during the past eighteen years has done valuable work, at present consists of some three hundred committees, having twelve hundred members, who give a great deal of their time to the work of standardization. This has become thoroughly recognized in Great Britain as an industrial question, and it is felt that each industry should determine its own standards, obtaining when necessary the help of outside engineers and experts in properly defining them for permanent records. The standards adopted by the British Engineering Standards Association are becoming more widely accepted, and that association is now regarded as the central authority for standardization.

In the United States a similar central standards association is necessary; otherwise separate standards may be adopted by a number of different engineering and technical societies. In the electrical industry there are already at least a dozen organizations developing standards in that field. To avoid confusion, it is evident that a central clearing house is necessary for the different standards proposed by different industries or organizations representing them, so that the standards suggested may be adjusted until one that is acceptable to all can be obtained.

Machine Tool Conditions in France, Italy, Switzerland and Holland

By ALEXANDER LUCHARS

Trade Commissioner, Department of Commerce, Bureau of Foreign and Domestic Commerce, Washington, D. C.

WHEN the contract was signed by the American Liquidation Commission to sell for $400,000,000 to the French government about three-quarters of the war material in France belonging to the United States government, a big transaction was completed. The material sold, which cost about $1,300,000,000, included, besides enormous quantities of machinery, supplies and materials, all the machine tools which had been sent to France by the War Department. As is usually the case, there is a wide difference in the estimates of the value and amount of the machine tools, among dealers and others interested, varying from 400,000,000 to 100,000,000 francs.[1] The latter sum I believe to be near the actual value.

Some of these tools are now being sold by the French government to manufacturers in the devastated areas, and some used elsewhere. So far these sales have not materially affected the sales of American tools here, these being in good demand, and many dealers say their volume of sales for 1919 exceeds that of the corresponding period for 1918. It is not thought that many of the machine tools involved in this purchase will come on the market, as the best will probably be retained for adjustments in government plants.

Although an added burden, dealers say the increased duty will not greatly affect the sales of American machine tools. As the duty is based on weight it will have more effect on the sales of heavy tools and machinery, most of which were supplied by England and Germany before the war.

The fear of German sales at prices based on the depreciated mark also overhangs the French market, and a few sales of heavy machines, such as presses, forging machines, boring mills, planers, etc., are said to have been made; but these sales concern the British rather than American manufacturers, as we were unable to sell such machines in Europe for several years before the war, principally on account of transportation costs.

French Machine Tool Manufacturers

The enormous expansion in the use of machine tools during the war has caused a surprisingly small increase in the number of French machine tool builders. Two or three of the older firms for some years have been using modern methods and these have enlarged their plants and improved their equipment. Others appear to have learned nothing since 1914.

There have been few changes among dealers. With the exception of the Associated British Machine Tool Makers, Ltd., there are no important additions to the number of French machine tool dealers since 1914. Most say that business is good, especially in the Northern and North Eastern parts of France; but even in those sections which suffered most from the German invasion some French manufacturers are buying German tools rather than American on account of the difference in price. The exchange rate with France, as with the other Allies, is very favorable to the Germans *in selling*, 45 francs equalling 100 marks. With the Swiss franc there is even more difference, 100 Swiss francs being worth 141 French francs. The purchases referred to are, however, confined to heavy machines. The large number of tools used in France during the war, most of which were creditable examples of American products, have been a great help in educating French manufacturers still further in the use of tools of the best quality.

[1] The French franc, now selling at about 12.5 American cents, is normally worth about 19 cents.

Labor

In spite of sporadic strikes, the French labor situation is settling down, and the thrifty habits of the French working people are reasserting themselves. The legal working day is eight hours, forty-eight hours a week; time is made up for Saturday half holiday; but in small factories the employes often voluntarily work nine and ten hours a day at a proportionate increase in pay. The smaller the shop the less attention is paid to the eight-hour day.

The prevailing wages in and around Paris, and in other manufacturing centers where labor is in good demand are as below. Less is paid in small centers, where living is cheaper.

	1914 Francs Per Hr.	1919 Francs Per Hr.
Lathe hands	0.95 to 1.25	3.75
Assemblers	0.95 to 1.90	3.80
Toolsmiths	1.25 to 1.90	4.00 to 5.00
Helpers	0.80 to 1.05	2.00
Molders	......	3.00

Automobile Manufacturers

The principal demand for machine tools comes from automobile manufacturers who are busily preparing for 1920. The duty of 70 per cent on American cars will almost close this market to them, especially as the Italian product is admitted at 15 per cent. All the high-priced French automobiles include special features that appeal to the French buyers, and which in the American product are sacrificed for increased output. The French are really *makers*—not manufacturers. There is, of course, no such market for automobiles here as exists in America, but some makers are trying for the low-priced field. One well-known manufacturer, formerly in the gear business, who is credited with having made a fortune in munitions, has changed over his plant to produce a low-priced car in quantities. He originally planned to produce one hundred cars a day, to sell at 8000 francs. He has reached an output of twelve cars a day, but is selling them at 10,000 francs.

As the Future Now Looks

From an agricultural, textile and luxury-producing country, France doubtless will be pushed into the manufacture of metal articles by her acquisition of iron ore fields; but this development will be gradual, for it takes time to change the habits, ideas and industries of a people. The Germans say that their toy industry represents the growth of more than a hundred years and cannot be taken from them by the British with an experience of less than five. It is probable that after the present demand for machine tools in France is satisfied, there will follow a quiet period, which in turn will be followed by a gradual and healthy increase in demand, as the manufacture of metal articles develops.

Industrial Outlook in Italy

The industrial outlook in Italy is uncertain. In the best hotels food is scarce—a sure indication, even to the hurrying traveler, that the needs of the working people are urgent. The lack of coal and other natural resources is a heavy handicap to any nation that seeks to thrive from manufacturing, although in Italy this lack is partly made up by the develop-

ment of water power, the sources of which abound in Northern Italy. The Italians fully appreciate the gravity of this situation and are making strenuous efforts to utilize their water power wherever practicable. Near Bellagio, in the Como district, where coal is selling at $70 a ton, five thousand men have been working for months developing a hydraulic plant to generate about 4000 horsepower for the railways.

The agents of American machine tool manufacturers are not of one mind as to the future for our tools in Italy, but are looking forward hopefully, now that the import restrictions have been removed. On certain lines of tools, especially heavy machines and the cheaper grades of machine tools, there is great fear of German competition, and we shall have difficulty in approaching their prices unless German manufacturers are further handicapped by labor and material costs. On heavy presses and forging machines, large radials and milling machines, planers and special tools for metal products, we shall be unable to compete with German prices on machines delivered in Italy. And the cheaper grades of standard machine tools, of which there are so many German makers, will appeal to many Italian manufacturers who are not educated to paying the difference between the best American tools and German products at 25 per cent to 33 per cent less. While a market will continue to exist in Italy for the best-known American tools, the exchange situation there, as elsewhere in Europe, is a heavy tax on our sales. The demand for high-priced labor-saving tools will come from such concerns as Ansaldo and Fiat, but it is much to be feared that the small manufacturers will be content with the cheaper and inferior tools. Ansaldo[1] continues their pre-war policy of general expansion, having no less than twenty-seven different establishments and six associated concerns employing 50,000 workers, men and women. The Fiat Works[2] made a considerable number of machine tools for their own use during the war and will continue to make lathes for the market.

Italian Machine Tool Makers

According to Ing. Michele Ferrero, president of the Association of Machine Tool and Small Tool Importers and Merchants, there were in Italy during the war, about a dozen factories producing machine tools exclusively, employing a total of 1500 workers, varying in size from 500 to 50 employes. There were also about thirty factories, producing machine tools as a side line. Of these forty-two factories only three or four of the smallest specialized on a single type of machine, the others building varied lines in the old-fashioned way. Now there are about a dozen employing some two thousand workers who are producing (some very good) lathes, shapers, small milling machines, drilling machines and a variety of special tools for metal sundries. The value of machine tools produced before the war was about thirty million lire[3] annually (at present prices) which rose during the war to ninety millions and is now, it is estimated, less than ten millions. Although there are a few Italian machine tool makers who produce machines of excellent quality, it does not appear from this showing, and from the conditions in other machine tool producing countries, that Italy will soon become an important factor in the production of machine tools.

Italian industrial conditions are subject to so many influences that it is difficult to forecast their future. Many factories that have been producing munitions and other war material have not yet returned to their pre-war product. A large part of the equipment in these factories consists of American machine tools, and many of these are coming on the market as the change-over to another product is being made.

Machine Tool Building in Switzerland

Before the war there were only two machine tool building concerns of any importance in Switzerland—the Oerlikon Works at Oerlikon near Zurich, and Fritz Wunderli at Uster. During the war a number of machine builders produced radials, boring mills, tool grinders, screw machines, small plain milling machines, small lathes and other light tools. Oerlikon, which is the oldest machine tool concern in Switzerland, with a reputation for good work, builds engine lathes, horizontal and vertical milling machines, No. 3 horizontal boring machines (floor and table types), radial drills, and have under construction a No. 2 milling machine, a type popular in both Switzerland and France; also a high-speed, geared-head lathe with hardened and ground gears made by Maag of Zurich and said to be quite a departure in that line. Oerlikon has also placed on the market a bevel gear planer, the general operating principle of which is similar to the Gleason machine. This machine is regularly manufactured in two sizes for cutting gears having maximum modules of 12 (2.117 diametral pitch) and 15 (1.694 diametral pitch), respectively. Three larger sizes have also been designed, the largest of which will cut gears having a maximum module of 35 (0.725 diametral pitch). Fritz Wunderli produces small universal grinders, two sizes, wet tool grinders, and surface grinders somewhat resembling Brown & Sharpe No. 2, which compare favorably with American machines. The Wunderli factory is small, but run on efficient American lines and has a reputation for good workmanship. During the war Wunderli built many small plain milling machines for England. Besides these firms there are a number of smaller makers.

The Swiss machine tool market is small; but there will continue to be a demand for American tools of high reputation, because Swiss mechanics appreciate tools of quality. The Swiss franc, as stated previously, is worth more than the French franc, so that German tools sell for correspondingly less, often less than half, and buyers institute comparisons between the American and German prices that are sometimes difficult to meet. It is evident that only the high reputation and sterling qualities of American machines will enable foreign dealers to sell them in the face of such price competition.

Conditions in Holland

Holland was an agricultural and a trading, rather than a manufacturing country when I was last there; and since then the increase in manufacturing is distinctly noticeable. Holland presents every appearance of prosperity. The cities are crowded with well-fed, contented-looking people; the towns are well kept and the fields full of fat cattle; but the world-wide causes for discontent exist there as elsewhere. Food is plentiful and looks high to the Dutch compared with pre-war prices; but only a few items are higher than in the United States. There are few automobile or motor trucks; fat Dutch horses pull the wagons through the streets.

When the blockade became effective, Dutch manufacturers and dealers were entirely cut off from American supplies. Only lately (July) have orders been coming through. One large shipbuilding company then began receiving deliveries on a steel order placed in 1916. Shipbuilding, which is one of the most important Dutch industries, was almost suspended for lack of material. German material manufacturers refused to sell the Dutch unless the latter executed an agreement that the ships built therewith should not be used by any of the Entente Allies for a period of five years; and similar restrictions were insisted on by British material manufacturers against the Central powers.

A good many Dutch machine tool dealers, being unable to get American tools turned to German makers, not only to keep their business going, but because—especially during the last six months of the war—German tools were offered at bargain prices; consequently, the Dutch market is glutted with them. It is estimated that these stocks can be worked off by 1920-1921, if shipbuilding and the other industries requiring them continue to be prosperous.

The German tools I saw in Holland, built during the last months of the war and since, were mostly of inferior quality and finish compared with those now produced by the best German makers; and if those in the warehouses are no better, there will be great difficulty in disposing of them even at bargain prices. They do not compare at all with the best American tools. Swiss tools cost about the same as American in Holland.

[1] Societa Anonima Italiana Gio Ansaldo & Co., Headquarters, Genoa.
[2] Fabbrica Italiana Automobili Torino, Headquarters, Turin.
[3] A lira is now worth between 9 and 10 American cents. Normal value, 19.3 cents.

German Machine Tool and Related Industries

By ALEXANDER LUCHARS, Publisher of MACHINERY

Having finished his work for the Department of Commerce on October 1, and resigned as Trade Commissioner on that date, Mr. Luchars reviews in the following article German industrial conditions and gives his personal opinions thereon. Mr. Luchars takes this occasion to express his appreciation of the uniform courtesy and consideration shown him by Secretary Redfield and other officials in the Department of Commerce.

THE outlook for the coming winter in Germany is most uncertain, and conditions as they exist in the spring will have much to do with her stability and future progress. The German coal which must be given up to France, leaves about 40 per cent of what was used last winter, when there was much suffering among the poor for lack of fuel. This shortage probably will be further increased by the prevailing strikes, and through loafing and slacking. In one Westphalia mine which formerly employed 6100 workers, and now employs 6700, the output is only about 50 per cent of what it was in 1914. The coal shortage will of course affect factories, so that many may close down or run on reduced time. It is expected that wages will be paid in such cases, partly by the government and partly by the employers, adding to the taxes which are already crushing all who have anything to tax.

These taxes often work severe hardships. A maker of small tools who had been in business for fifty years sold out for a million marks. The new law took M. 800,000, and as the income of the remainder was not enough to live on, he went to work again at the bench in his former shop. Besides the taxes on income and profits, those on principal or business capital range from 15 per cent to 65 per cent; but the payment of the latter may be made in thirty annual installments at 6 per cent interest. Many people, especially among the business classes, are very despondent, and even faithful workmen (there are many) seem to have lost heart in their work, saying that there is no incentive to labor, for they can save nothing, and the product of their toil goes only for taxes and indemnities.

Labor Conditions

Employers are harassed by labor's demands and restrictions, by the difficulty of obtaining material, of disposing of their product when it is ready, by the depreciated currency which forms the basis of trade, by the enormous taxes, and all the minor troubles which follow in the train of these greater ones. But the future is not all gloomy. There are some who say that if the workmen will only *work* for whatever wages can be agreed upon, the other evils can be taken care of in time. Some believe labor is beginning to see that the demoralization in fundamental conditions affects working people more than any other class, and that some reasonable working basis must be reached on which the employer and employe can stand.

The strike at the great Siemens' works, employing 32,000 hands, is typical of German industrial conditions. This strike was caused by the tearing down of a notice posted by the management that on July 21, the international "strike day," all the Siemens' plants would be open to those who cared to work. In every works there is a shop committee which, with the management, passes on certain questions that concern the employes (too intricate an arrangement to explain here), and all notices relating to such questions are to be signed by both the management and the shop committee. The notice in the Siemens' works was not signed by the committee, the management claiming that it was not included in the provisions referred to. When the notice was torn down the forty-one members of the shop committee were discharged, whereupon 10,000 workmen began "passive resistance" (loafing around the shop during the working hours and doing no work). These men were told that they must work or be discharged, and, refusing, they were discharged. Then the remaining 22,000 workers struck. Finally, when the shop committee acknowledged that they had exceeded their rights in tearing down the notice, they were taken back and the remaining 32,000 came back.

A law has been introduced in the National Assembly giving a representation in the management of each business to the workers, but many manufacturers do not think that such a representation would mean interference. Partial strikes in departments of vital importance to the works are a favorite resort; for in such cases the workers in the departments not on strike come to the shop and play at working, but produce almost nothing for lack of material, causing great loss to the management who must pay their wages. In the case of total strikes no wages are paid.

Clerks and sales people here are all organized, having committees and rules similar to shop workers. Employers who have to deal with both classes say that the former are, if anything, more difficult to handle than the latter.

One serious obstacle to stability and progress is the lack of a recognized national executive. The President is a figurehead, and the ministers, with the exception of Noske, have no real power. Noske, the Minister of National Defense, derives his power from the willingness of the soldiers to execute his orders; but except for its officers, the army is made up mostly of men who remain in it, not from motives of patriotism, but for the pay and food, and when a better place offers many leave. Its reliability is said to be increasing, and is the saving factor in a precarious situation.

No one in Germany seems to believe that the country will ever regain her former position. Conservative business men say that the return to normal economical conditions is not a question of month but of years; one whose opinion is considered of great value, puts the time at from five to ten years. Such men point to the complete change in the morale of the working classes, and the prevalence of thieving in communities where it was unknown before the war. Food now controls the situation, and unless it becomes more abundant and cheaper during the coming winter, many expect another revolution which will leave the country worse off, as each change under present conditions will lower the standard of those in authority. The supply of certain kinds of food is fortunately increasing. Contrasting conditions with those of some time ago, one German machine tool dealer described the present food as "splendid." Meat and bread cards are still required. The former entitles the holder to two portions of meat and the latter to five slices of black bread daily. Fairly good bread is obtainable at the high-priced Berlin hotels, but the bread eaten by most people is made of potatoes, flour and straw.

Cost of Living and Wages

Prices of all kinds of labor, of metals and materials, and especially of machine tools, have naturally increased much more in proportion than in America—and prices have increased here since the armistice, although the supply of labor should be greater. The cost of living, therefore, is high.

A general comparison of wages paid to machinists and machine shop workers in 1914 and 1919 is given below.

COMPARISON OF WAGES IN THE GERMAN MACHINE INDUSTRIES, 1914 AND 1919

	Wages Per Hour, Marks 1914	1919
Lathe hand	0.60 to 0.75	3.25 to 4.00
Milling machine hand	0.56 to 0.60	2.55 to 3.50
Planer hand	0.60 to 0.72	2.90 to 3.75
Assembler and fitter	0.56 to 0.70	2.70 to 3.60
Drilling hand	0.48 to 0.56	3.00 to 3.50
Blacksmith	0.95 to 1.15	3.50 to 4.00

On piece-work, the man must be guaranteed a minimum wage of about 25 per cent more than for day work. There are no large wages earned at piece-work, for the men will not produce more than an average amount of work under any conditions.

The above figures, however, do not afford an accurate comparison of labor costs on account of time lost loafing, talking and "slacking." In the machinery industry the average hourly product under the eight-hour day is about 50 per cent of what it was in 1913-1914. In the Ludwig Loewe works it was said that the product per man per hour for the first six months of 1919 was 52 per cent of what it was in 1913-1914. In some works it is much less.

Besides the increased wages and diminished output, manufacturers must reckon with extra bonuses or contributions in cash, up to M. 800 for each person or member of the organization such as foremen, draftsmen and superintendents, to enable them to pay their debts. The upper class employes have been giving more trouble lately than the workers.

Hours of Work

All over Germany the eight-hour day prevails, but the division of the day varies in different localities. In most Berlin machine shops the workers start at 7, work till 12.10, take twenty minutes for lunch, and quit at 3. On Saturday the quitting hour is 1, making 44½ hours a week. In the Spandau arsenal when the armistice was signed there were about 40,000 workers employed. The government dared not throw them out of work, so they continued to come during hours, but produced nothing, because whatever they produced would have represented only spoiled material. After some months of this it became evident that M. 25,000,000 a month could be used to better advantage in other ways, so the force was cut down.

Cost of Materials

The following figures give an idea of the increases in the prices of materials from 1914 to 1919. The heavy increases in prices are due not to profiteering, but to greatly increased manufacturing, transportation and other costs. Foundry pig iron, which was quoted at M. 74.50 in the second quarter of 1914, was quoted at M. 215 in the first quarter of 1919, and M. 356.50 in the second quarter of this year. Prices have now been lowered by M. 52 to M. 90 per ton, but the Pig-iron Union states that the blast furnaces are working at a heavy loss.

The materials used in making pig iron have, of course, increased accordingly, coal briquettes having advanced from M. 13.75 to M. 66.10, and blast furnace coke from M. 17.00 to M. 88.85 per ton.

The advances of prices for raw and half-finished products are given in the following table. The prices given are marks per ton.

	Ingots M.	Billets M.	Sheet Billets M.	Sections M.
May 1914	82.50	95.00	97.50	110.00
January 1, 1919	285.00	300.00	305.00	320.00
March 1, 1919	385.00	400.00	405.00	420.00
May 1, 1919	405.00	475.00	480.00	520.00

Copper is selling at M. 5.25 a kilogram (official price). High-speed steel sells for M. 27.50 per kilogram.

There is no room in this article for an extended comparison of prices; but a few typical examples may be of interest: A freight locomotive, which cost, before the war, about M. 80,000 and in 1918 about M. 225,000 cannot be bought now for less than M. 400,000. Gasoline costs about M. 18 a gallon; automobile tires, 32 by 4½, M. 1400; bicycles, M. 1500. A Ford automobile, three years old, without tires, sold recently for M. 10,000. Second-hand American typewriters sell for M. 1200; typewriters of German make, M. 1200. These are, of course, transient prices; when supplies come in, they will fall sharply.

Machine Tool Output During the War

The following table, compiled by Professor Schlesinger, an authority on the subject, gives the output of German machine tools during the past six years, and a comparison of prices as well:

GERMAN MACHINE TOOL PRODUCTION—1913-1918

	Production in Million Marks	Selling Price, Mark per Kilogram	Production in Tons
1913	1060	1.00	1,060,000
1914	1045	1.10	950,000
1915	695	1.30	530,000
1916	660	2.00	330,000
1917	1720	2.50	680,000
1918	780	3.00	260,000

Many and varying estimates have been made of the value of machine tools now in stock in Germany, but conservative authorities place the amount at between M. 200,000,000 and M. 300,000,000, which is a normal figure. This does not include tools owned by the government, but those are not expected to come on the market. The tools in private stocks are said to be second or third rate products; and this statement is supported by the fact that nearly all first-class German machine tool makers are behind in their deliveries—some claim from six to nine months.

Machine Tool Prices

All German prices must be considered in relation to the impaired value of the mark, which in the latter part of October, 1919, was quoted at about 27 to a dollar, as compared with 4¼ in 1914, and similar, although not so great, differences are noticeable in comparison with all Allied and neutral money values. Its effect on imports into Germany is evident, and establishes prohibitive prices for American machine tools there. The price of German machine tools was advanced three times by the government during the war—43½ per cent in 1917, and in 1918, 66 per cent over the 1917 prices. No further government advance was made, but manufacturers advanced prices from 20 per cent to 40 per cent at the end of 1918; and many prices have further advanced (except on war material tools) during 1919. Special machines for peace work use advanced up to 200 per cent, and some small machine tools as much as 500 per cent over 1914 prices. But German tools of the best makes still sell for considerably less than similar American tools can be sold for, according to the following figures furnished by two well-known German dealers:

1919 PRICES FOR BEST MAKES OF GERMAN MACHINE TOOLS

	Marks
Gap lathes, 12-inch, 3½ feet between centers	3400
Gap lathes, 16-inch, 3½ feet between centers	4800
Gap lathes, 16-inch, 5 feet between centers	5100
Gap lathes, 18-inch, 3½ feet between centers	4500
Gap lathes, 20-inch, 5 feet between centers	7400
Gap lathes, 20-inch, 7 feet between centers	7750
Gap lathes, 26-inch, 7 feet between centers	10300
Engine lathes, with gap, lead-screw and feed-rod, 16-inch, 5 feet between centers	7000
Engine lathes, with gap, lead-screw and feed-rod, 18-inch, 3½ feet between centers	8000
Engine lathes, with gap, lead-screw and feed-rod, 18-inch, 5 feet between centers	8500
Plain milling machines (according to size)	4000 to 9000
Universal milling machines (according to size)	7500 to 8500
Vertical milling machines	7200
Crank shapers, 14-inch	4200
Crank shapers, 18-inch	5000
Crank shapers, 22-inch	7000
Drilling machines, 20-inch	1300
Drilling machines, 22-inch, power feed	2700
Four-spindle automatics, 1¾- and 2⅛-inch	26,000 to 27,500

My personal opinion is that the above prices are lower than those for which first-class machines can be bought.

COMPARISON OF PRICES OF GERMAN MACHINE TOOLS—1914-1919

	Marks 1914	Marks 1919
High-speed engine lathe, geared-head, 18-inch, 3½ feet between centers	2800	9000
Tool-room lathe, 14-inch, 3½ feet between centers	2400	8600
Milling machines, hand	230–280	950
Plain (three different sizes)	800	2700
	2600	8100
	4400	13,000 to 14,000
Universal, including head	3500	10,000 to 12,000
Radial drilling machines, 3½ feet	2400	8000 to 10,000
5 feet	4800	16,000 to 18,000

All prices stated are subject to change from day to day, and many manufacturers refuse to quote prices until the tools are ready for delivery.

No American machine tools have come into Germany, except through Holland and Sweden, for about three years, and no reliable comparisons can be made between the selling prices of our tools here in 1914 and the prices that would have to be put on them now. The high ocean freight rates, which will undoubtedly fall in the near future, and the low value of the mark, make any comparison of little value; but judging by what former agents of American manufacturers say, the figures would range from four to seven times what they were in 1913-1914, and from 50 to 75 per cent more than similar German tools sell for. One dealer estimated that an American 14-inch lathe, which he sold for M. 2000 in 1914, he would now have to sell for M. 11,000 to M. 12,000, while a German tool of the same size and of a good make would sell for M. 6000 to M. 7000. A Gleason bevel gear planer, sold here in 1914 for about M. 9000, would now have to be sold for M. 60,000. A Baker Bros. type keyseater, 13-inch stroke, weight 2250 pounds, made by A. H. Schutte, is offered at M. 5500. A four-spindle automatic by the same maker is sold for M. 27,500; 10- to 12-inch lathes made by Pittler, one of the best manufacturers, sell for M. 1000 to M. 1200. On account of their greater accuracy, American tools of the best makes will sell for better prices than German tools of the same type and size; but to say just how much more would be pure guesswork.

The German manufacturers are turning out far better tools than they did in 1913-1914. The designs of many well-known American tools are followed, some are faithfully copied and others adapted by the leading German makers. The German designers have made few changes in machine tools, and few new machines have been brought out. On account of the tendency to copy American machines, or, if not in their entirety, to use their new points, our manufacturers are cautioned about accepting first orders for such machines.

Verein Deutscher Werkzeug-Maschinen-Fabriken

The German Machine Tool Makers Association numbered 72 before the war. It has now 320 members, and they apparently work together for much the same objects that our own association does, except that they are free to regulate prices to any extent they choose. Neither the Germans nor the English are so far advanced as we are in governmental regulation of business. So they have some things to be thankful for. The members of the association employed about 70,000 men and a large number of women in 1917; 60,000 men and fewer women in 1918-1919. A complete list of the members of the association and their products would require too much space, so it will be sufficient to mention the number of makers of different classes of machine tools at the present time:

Engine lathes	90
Vertical boring mills	13
Cutting-off machines	20
Horizontal boring machines	27
Gear-cutting machines	19
Turret lathes, screw machines and automatics	37
Milling machines, all types	83
Drilling machines, all types	43
Planers, slotters and shapers	44
Grinding machines, all types	40

There are said to be some sixty automobile factories in Germany, but not more than a dozen are active, and only a few of those have been able to get material to turn out a normal product. Before the war, few of these manufacturers produced cars as we do in the United States. It is said there were 190 different kinds of cars made. The financial outlook in Germany does not warrant large investments in the manufacture of either pleasure or business cars.

The Tariff and Patents

No definite policy has yet been decided on about the tariff, although it is said that a high protective duty will be placed on imports. The National Assembly being only a provisional body, it is likely that this question will be left to its successor, but there is a marked tendency among those having authority, to arbitrarily shut out all American machine tools, except those types which are not made here.

There has been no important change in the German patent law since 1909; and American manufacturers are advised to patent any improvements that are patentable—not only for their protection in Germany, but in other continental countries where German tools may be sold. According to the German patent laws in effect at the beginning of the war, a patent could be revoked after a period of three years from the date on which a notification of the granting of the patent had been published in the German official gazette, if the patentee had failed to work the patent adequately within Germany or if he had not taken measures to insure the working of the patent. The patent could also be revoked if it was beneficial to the public that others should be allowed to make use of the invention, and the patentee refused to issue licenses for this purpose when offered reasonable compensation and security.

These provisions were changed somewhat by a law which has been in existence since June 16, 1911, and which relates to the compulsory working of patents. According to this law the former provisions do not apply to citizens of any country with which Germany signs a special treaty of patent reciprocity. Such a treaty was concluded between Germany and the United States on February 23, 1909, and, therefore, the above provisions no longer apply to citizens of the United States. According to this treaty, the working of a patent or registered trademark in either country concerned in the treaty, was considered equivalent to the working of the same in the other country. In other words, a citizen of the United States was not obliged to work a patent in Germany if he could show that the requirements of the United States were fulfilled and that the patent was being worked in the latter country. This treaty was, of course, suspended by the declaration of war and no decision has been rendered as to whether the treaty will be permanently revoked or be reinstated.

In Article 307 of the Versailles peace treaty of 1919, it was agreed that patents which were in existence on August 1, 1914, cannot be cancelled on account of not being worked, until the end of a period of two years from the date of the ratification of the treaty. Compulsory licenses can be granted during this two-year period and afterward.

The Central European Nations

In what remains of Austria, the machine tool industry is on an uncertain footing, due to unsettled conditions and a debased currency. In Hungary, the new government is too young for anyone to venture an opinion about the future, except that any government must be an improvement over what Hungary has had lately. In Prague business is said to be encouraging, and the Czecho-Slovak government apparently is growing in strength. Machinery dealers in Berlin also say they are doing a good business with Finland.

Everyone whom I saw in Germany was friendly, and there is no animosity against Americans as individuals; but there is a strong feeling against us as a nation. The Germans say that if we had not come in they would have won the war, and they are not of the readily forgiving kind. This feeling will affect the sale of American machine tools and other products in the future, although those who must have certain types of tools, made only in America, will buy them.

U. S. GOVERNMENT SALES AND BELGIAN MACHINE TOOL CONDITIONS[1]

By ALEXANDER LUCHARS, Publisher of MACHINERY

A MATTER of great importance to American machine tool manufacturers is the amount and effect of the sales of tools by the United States War Department in Belgium. As our manufacturers already know, these are being sold at 1914 prices plus 55 per cent C.I.F. Antwerp; the 55 per cent being figured not only on the 1914 cost of the tools, but on the freight and other costs. Three years' time is given the buyers by the Belgian government, and this item in the terms is perhaps more attractive to the buyers than the low price. A further discount of 10 per cent is given for each year a tool has been in use, unless it has been used so little that its value has not been affected.

Under the arrangement made, the U. S. War Department sells these tools to the Belgian government, which markets them through *La Construction Metallique,* a co-operative society organized to do business without profit, and composed of Belgian manufacturers in the machinery and metal manufacturing industries, any one of whom may become a member by paying a small fee. Any member of *La Construction Metallique* may buy any number of these machines on the above terms, without regard to whether or not they are to replace machines stolen by the Germans. *La Construction Metallique* includes eighteen subsidiary groups of manufacturers, among them makers of automobiles, locomotives, machine tools, motors, engines, etc. The original arrangement for financing these sales was based on a credit of $22,000,000 granted to the Belgian government by ours; $3,000,000 worth of machine tools were sold, and it was then found that the $22,000,000 credit had been used by the Belgian authorities without reserving any of it to pay for the tools. After some delay a second arrangement was made which is now in force, under which the tools are to be paid for from the $50,000,000 Belgian credit recently negotiated with American banking institutions.

It was stated by an officer in authority that it was expected to sell in all about 4,000 machines. The selling of small tools is now being considered. The sales are made in dollars by the U. S. War Department; and the prices at which the machines are bought by Belgian manufacturers are presumably subject to the fluctuations of exchange, unless a heavy loss is to be made up somewhere.

One of the officials in charge of these sales advanced the following reasons in support of them: (1) That the tools had to be sold *somewhere,* and that they would probably do more good in Belgium than elsewhere and would also keep the Germans from selling a considerable part of the amount. (2) That the Belgians need tools badly to re-equip their factories, and have not the money to buy them on ordinary terms of payment. (3) That many Belgian manufacturers are buying American tools who never had one in their shops before, and this sale should make a future market for them which will be worth some transient loss.

The Belgian machine tool dealers are not considering the proposition from any philanthropic standpoint. They say that the prospective enormous Belgian demand has almost disappeared, because manufacturers are waiting to see how much of their equipment they can get from Uncle Sam. One dealer told me that for this reason an order amounting to 300,000 francs, with prospects of a further increase to a million, was cancelled. Another dealer says that machines sold by the United States Government are being bought only by those who have had considerable experience in the past with American tools and know them well. The medium sized and small plants that have been the largest buyers of German machines heretofore have not so far bought any American tools and appear to be waiting until they can again buy in Germany. In spite of this heavy load on the market, a fair business is being done in American tools at current prices, showing that except for this sale a splendid business would be going on.

After investigation there seems to be no doubt that receipts were in most cases given by the Germans for the machine tools and other machinery stolen from Belgian works, and that the tools were also tagged or otherwise marked to facilitate identification. It is also true that an effort is being made by the German authorities to collect and return these machines. Mr. Rother, one of the staff of Schuchardt & Schutte in Berlin, is in charge of the return of these machine tools. But restitution is not easy. It is stated on good authority that only about one-fifth of the machine tools taken away have been returned. The Cockwill Works, from which some 3500 were taken, have had about 300 returned. The Minerva Works, which lost a large number, have gotten back almost none. Many manufacturers are not trying to get their machines back, apparently expecting to buy new ones through *La Construction Metallique* or some other source. There is no special fund to reimburse these manufacturers for money spent for reparations. They will have to wait the distribution of the indemnity, probably a process of years.

All the important Belgian works are said to have placed large orders for machine tools—some in the United States and some in Scandinavia. I heard of none being placed in Germany, but some people say that if the difference in price continues it is only a question of time before it will be done.

The cheap labor which made Belgium a formidable competitor in European and foreign markets is as much ancient history as the 34 shillings a week of the Yorkshire machinists. Belgian labor has gone up since the war and may keep on going up, although some people here think that the apex has been reached. It is reasonably certain to work up to an equality with that of other European countries.

Employers seem to recognize the changed conditions and have not only increased wages, but have arranged a gradual reduction of the hours of work, which were 10 before the war, are now 9, will soon be reduced to 8½, and in 1920 to 8. Some plants have an eight-hour day now. Machinists' wages have increased from 225 per cent to 295 per cent (the present rate being from 19 to 34 U. S. cents an hour) according to the locality and class of work.

Those who are particularly interested in the development of Belgian industries of all kinds should send to the Department of Commerce for the reports of Trade Commissioner H. T. Collings, who has been in Belgium for about a year, and during that time has compiled a mass of valuable information regarding the industries he has been investigating.

There have been quite a number of changes among Belgian dealers during the war. The A. H. Schutte warehouse was leased by the Allied Machinery Company, and recently bought by Alfred Herbert, Ltd., who will occupy it as soon as the Allied lease expires. Isbecque & Company have given up their Antwerp place, and their main office and wareroom are now located at 36 Rue Otlet, Brussels, where they have very convenient accommodations. Henri Benedictus has also closed his Antwerp place and has taken the Steinhaus quarters at 133 Rue due Progress, which are well adapted to his business. R. S. Stokvis & Fils are at the same place, but find it too small for their requirements. Fenwick Freres still have their Belgian headquarters at Liege, but have decided to move to Brussels in about three months, and the tendency among Belgian machine tool dealers is to concentrate in that city.

For many years previous to 1914, Belgium was a hive of industry, and I believe she will recover more quickly from the effects of the war and enjoy a greater proportionate degree of prosperity than any other European nation. And I think Belgium's prosperity and expansion will work out largely in the manufacture of metal products. Higher wages having come to stay, Belgium will be a very large buyer of machine tools, especially labor-saving machines, and the great part of these machines will be bought by hundreds of small shops that we never have heard of, which will start up, grow and expand with Belgium's growth and expansion. Whether or not most of these tools will be bought in the United States depends upon a number of factors—the principal one now is exchange. France and Belgium will buy in future where they can get the most for their money.

[1]Abstract of a letter which is the concluding one of a series on conditions in the machine tool and kindred industries in Europe.

Turret Lathe Practice

Second of a Series of Articles Dealing with Tooling Equipment and Order of Operations for Turret Lathe Work, Based Upon the Experience and Practice of the Gisholt Machine Co., Madison, Wis.

By ERIK OBERG

IN the first article of this series, the machining of flywheels and auto truck wheels was dealt with. In the present article, tractor axle housings, wheel hubs, and motor frames will be described.

Machining an Axle Housing

Fig. 1 shows an axle housing for a tractor, the surfaces finished on the turret lathe being shown by heavy lines. The machining of this part on the turret lathe brings out the application of so-called "chuck bonnets" or fixtures used for holding parts having elongated irregular shapes. Such a chuck bonnet is used for the first operation on this axle housing, while a so-called chuck-plate fixture is used for holding the work in the second operation. The material of the housing is cast iron, and the tooling equipment is applied to a 24-inch Gisholt turret lathe.

Fig. 3 shows the lay-out of the tooling equipment for the first operation, which consists in machining the front end of the housing and boring and reaming the hole. The order of the steps in the first operation is as follows: (1) The housing is held in a special fixture or cradle having an arm which encloses it and steadies it near the outer end. Fig. 3 shows the arrangement in diagrammatical form, while Figs. 7 and 8 show the fixture more clearly. Fig. 5 shows the complete tooling equipment as applied to the turret lathe. (2) Surfaces *A* and *B*, Fig. 3, are rough-turned and faced with tool *H* in the toolpost. (3) Hole *C* is rough-bored with a cutter held in the boring-bar mounted in Side 1 of the turret. Fig. 7 shows the boring-bar just starting this cut. (4) Hole *C* is finish-bored with a cutter held in the boring-bar mounted in Side 4 of the turret. During both the rough-boring and the finish-boring operations, the bar is guided by a pilot entering into a bushing in the chuck, as indicated in Fig. 3. (5) Hole *C* is reamed with the reamer mounted in Side 5 of the turret. (6) Surfaces *B* are finished with cutters held in the head mounted in Side 2 of the turret. During this operation, the head is steadied by a bushing on the end of a pilot which enters into bore *C* and which also insures concentricity of the finishing cut at *B*. This operation is shown in Fig. 8. (7) Shoulder *A* is finished with tool *I* held in the toolpost. The total time for the first operation is 8 minutes.

The lay-out of the tooling equipment for the second operation on this axle housing, which consists in machining the surfaces *E* and *F*, chamfering at *G*, and tapping the hole at *D*, is shown in Fig. 4. A halftone illustration of the tooling equipment is shown in Fig. 6, while Fig. 9 illustrates more clearly the method by which the work is held in this operation. A special chuck plate is used which is attached to the regular faceplate of the machine. The step-by-step operations are as follows: (1) The housing is mounted on the chuck plate and held with clamps. (2) Surface *F* is rough-faced with tool *K* in the toolpost. (3) Hole *E* is bored, and a chamfer is cut at *G* with cutters held in the head mounted in Side 1 of the turret. During this operation, the head is guided by a pilot entering a bushing *L* in the chuck plate. (4) Surface *F* is finish-faced with tool *M* held in the toolpost. (5) The hole at *D* is tapped with a tap held in Side 4 of the turret. The total time for the second operation is 6 minutes.

Tooling Equipment for Finishing a Wheel Hub

Fig. 2 shows a wheel hub which is finished on a 21-inch Gisholt turret lathe in two operations. The hub is finished on all the surfaces indicated by heavy lines in the illustration. Fig. 10 shows the lay-out of the tooling equipment for the first operation, and Fig. 11 shows the equipment in use on the machine. This is an example of the application of the turret lathe for the finishing of small parts and fill-in jobs. The wheel hub illustrated was the main job for which the turret lathe was installed in this instance, but as the machine could not be kept entirely busy on this work, it was also used for finishing another hub part shown in Figs. 14 and 16, as well as the part shown in Figs. 15 and 17.

Referring to the first operation on the wheel hub, as illustrated in Figs. 10 and 11, the step-by-step operations are as follows: (1) The hub is held by special hard chuck jaws as illustrated in Fig. 11. These jaws are grooved at the outer end to fit the rim of the flange of the hub. (2) Surfaces *B*, *C*, and *D* are rough-machined with tool *H* in the

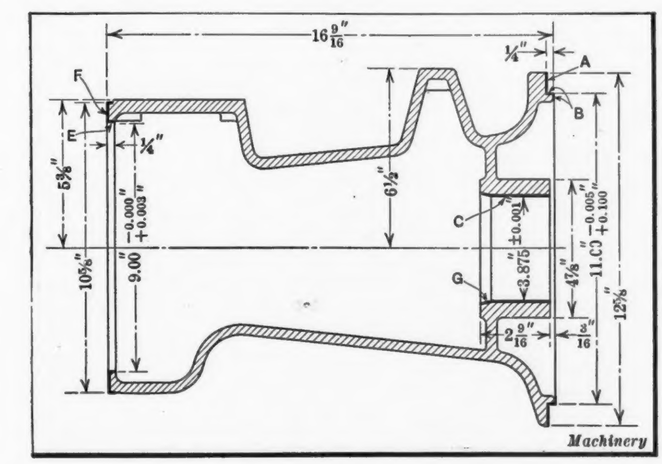


Fig. 1. Axle Housing for Tractor

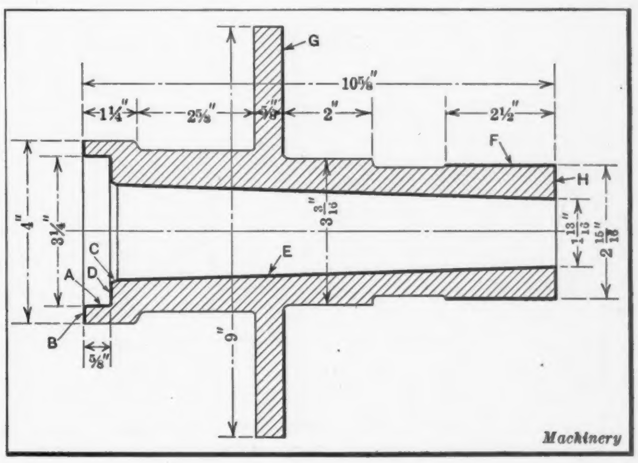


Fig. 2. Drawing of Wheel Hub

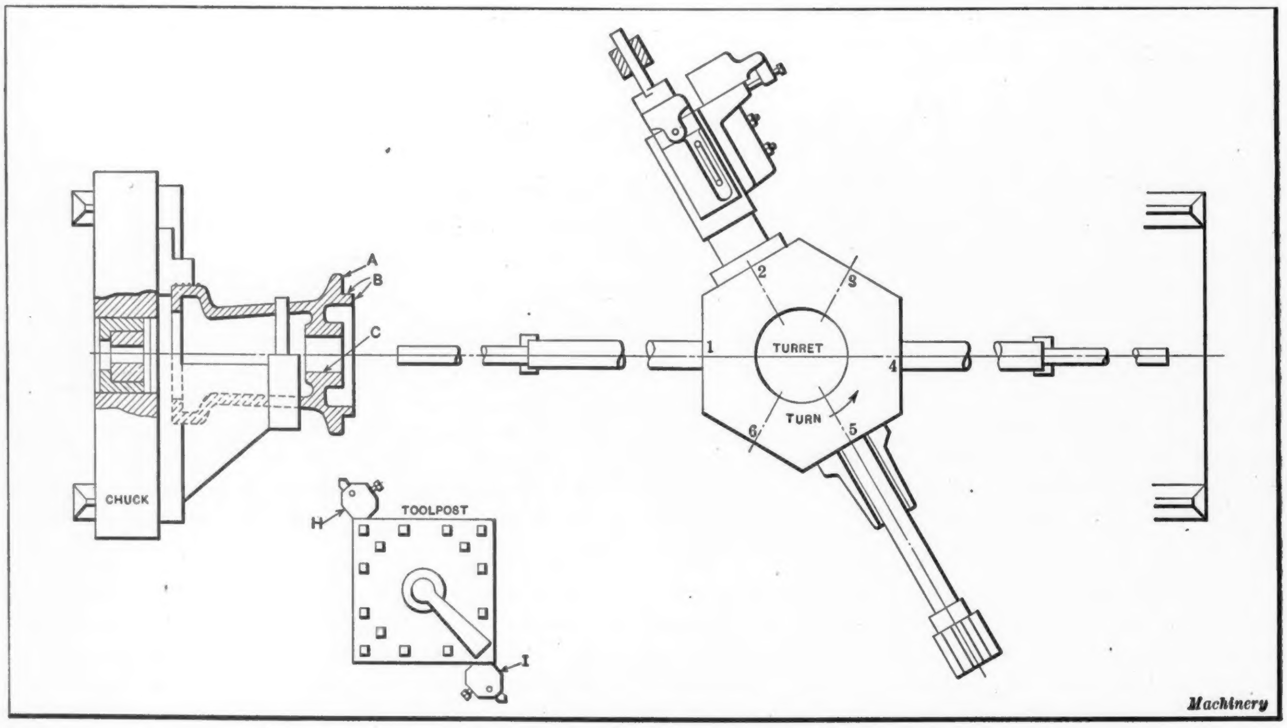


Fig. 3. Tooling Equipment for First Operation on Axle Housing shown in Fig. 1

toolpost. (3) A second roughing cut is taken on surfaces *C* and *D* and a first roughing cut in holes *A* and *E* by the multiple cutters held in the boring-bar mounted in Side 1 of the turret. Fig. 11 shows the boring-bar just entering the work. (4) A second roughing cut is taken in holes *A* and *E* with the taper reamer and cutter mounted in Side 3 of the turret. (5) A finishing cut is taken in holes *A* and *E* with the reamer and cutter mounted in Side 5 of the turret. The total time required for the first operation is 6 minutes.

Fig. 13 shows the tooling equipment for the second operation on the hub. In this case, the hub is held on a taper arbor with a lathe dog used as a driver in the ordinary way. Fig. 12 illustrates clearly the method of holding and driving the work, and also shows one of the heads mounted in the turret in operation. After having placed the work on the arbor, surfaces *F*, *G*, and *H* are rough-turned and faced with tool *I* held in the toolpost, after which surfaces *F* and *H* are finish-turned and faced with cutters held in the head mounted in Side 1 of the turret. (See Fig. 13). Finally, the outside of end *F* of the housing is threaded with a die mounted in Side 4 of the turret. The time required for the second operation is 9 minutes.

Figs. 14 and 16 show how the turret lathe is applied for the finishing of another hub part as a fill-in job. In this case only the hole *A* and the end *B* are finished. The work is held by special chuck jaws in much the same way as the hub in Fig. 11. The surface *B* is faced with a tool held in the toolpost, while the hole *A* is bored with a cutter in the boring-bar mounted in the turret. This is all the work performed on this hub part, and the time required for the operation is 1 minute.

Another hub part in the form of a bushing is machined by the equipment shown in Figs. 15 and 17. The material is malleable iron, the part being known as a hub-point band. This part is held by special hard chuck jaws, as indicated, after which the end *B* is faced with a tool held in the toolpost. Hole *A* is then bored with a cutter held in the boring-bar mounted in Side 5 of the turret, this bar having a pilot which enters a guiding bushing in the chuck. This operation is illustrated in Fig. 17. Finally, the hole is tapped with a tap mounted in Side 4 of the turret. The total time required for performing these operations on the hub-point band is 2½ minutes.

It should be thoroughly understood that the makers of the machine and tooling equipment emphasize that it would not be economical to buy the machine to perform the operations

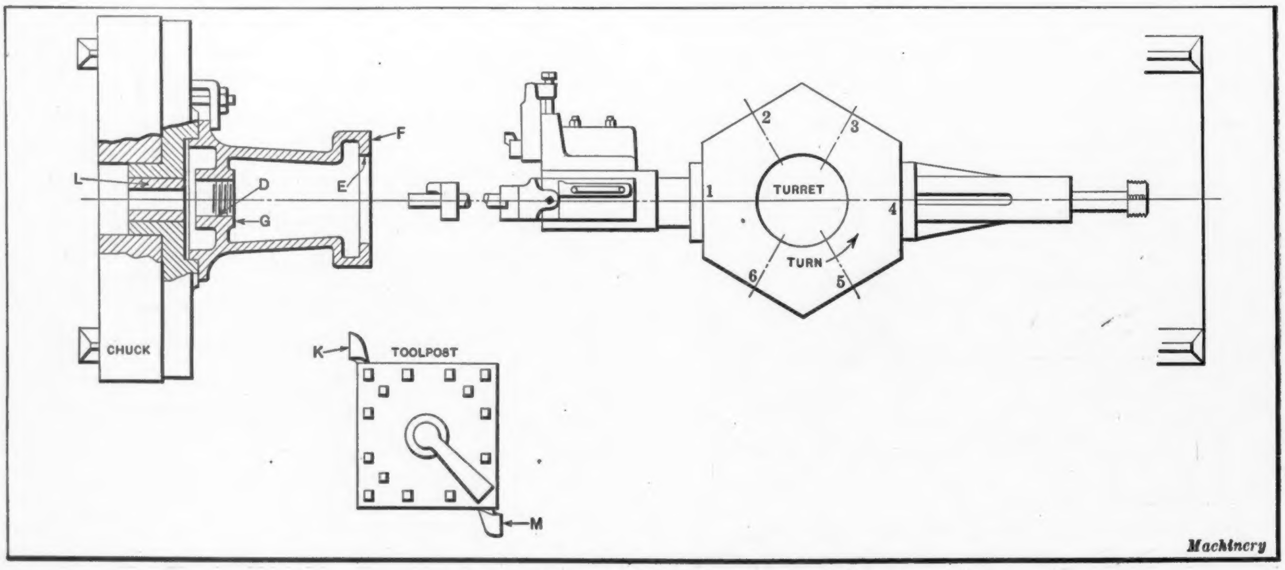


Fig. 4. Tooling Equipment for Second Operation on Axle Housing

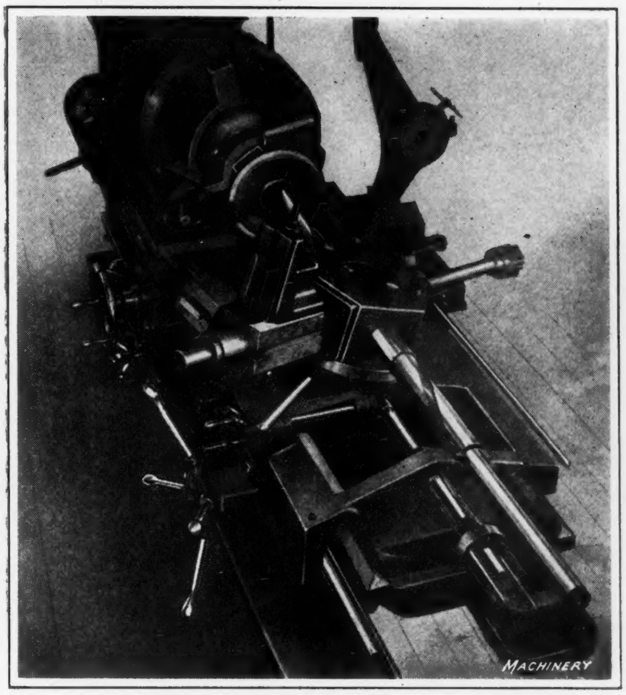


Fig. 5. Machine set up for performing First Operation on Axle Housing

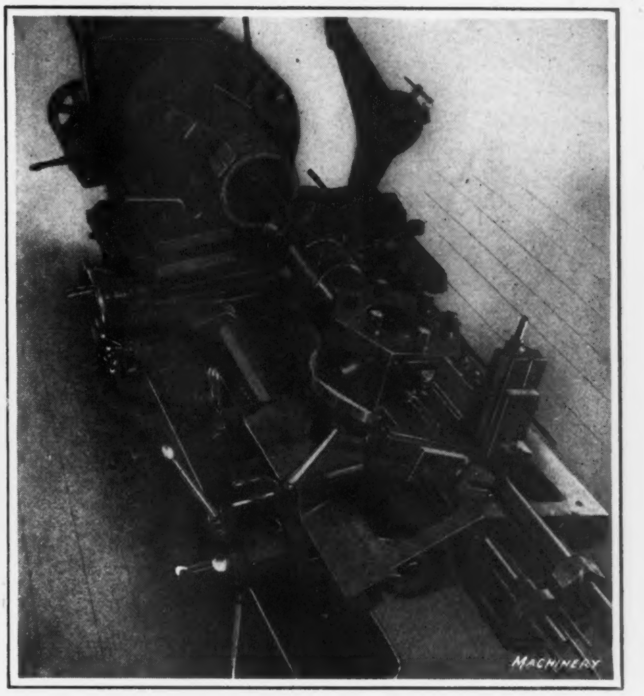


Fig. 6. Machine set up for performing Second Operation on Axle Housing

on the two small hub parts shown in Figs. 14 and 15, if there were no other turret lathe work available, but when the machine is procured for performing work of the type shown in Fig. 2, it may be the most economical method to perform the operations on the other hub parts in the same machine, especially when it is not kept busy on the work for which it is better suited. There is no question but that when the machine is available the work on the smaller hub parts can be performed more quickly on the turret lathe than by any other method, and the examples shown are intended to bring out the fact that the turret lathe often can be used to advantage for performing operations as fill-in jobs for which it would not be bought if there were no other work for which it had been especially obtained.

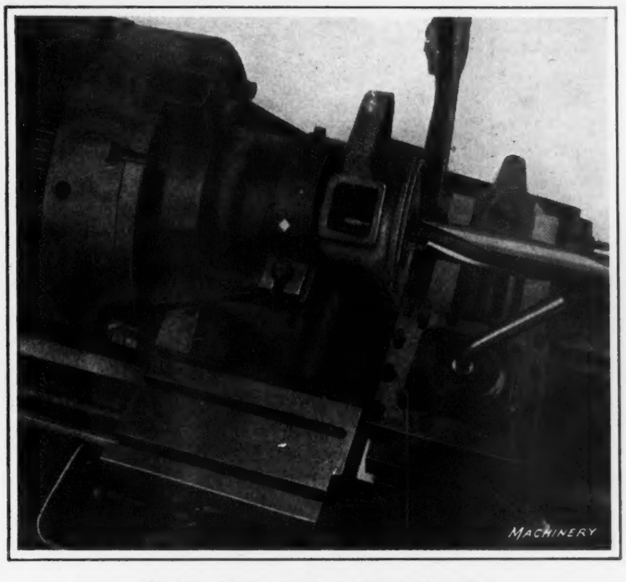


Fig. 7. Boring Hole in First Operation

Equipment Required for Machining a Motor Frame

Fig. 18 shows a motor frame machined on the surfaces indicated by heavy lines. The tooling equipment required for machining this piece in two operations brings into use the auxiliary toolpost or wing-rest in addition to the toolpost tools and the turret tools. The work is performed on a 24-inch Gisholt turret lathe. The material of the motor frame is cast steel.

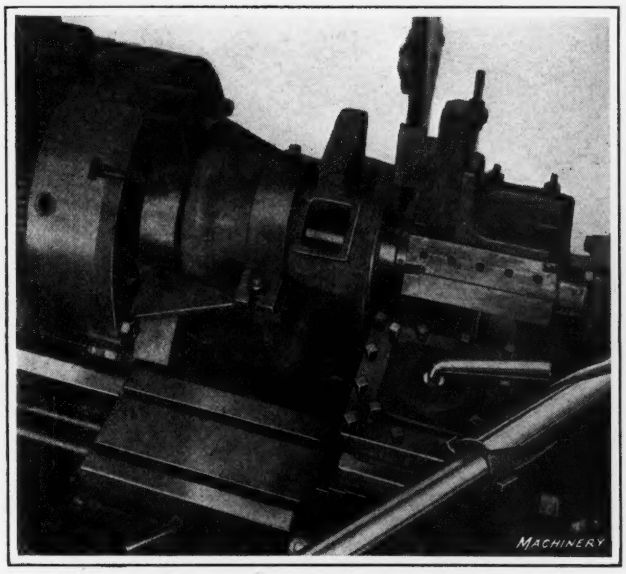


Fig. 8. Facing Head brought up to Work

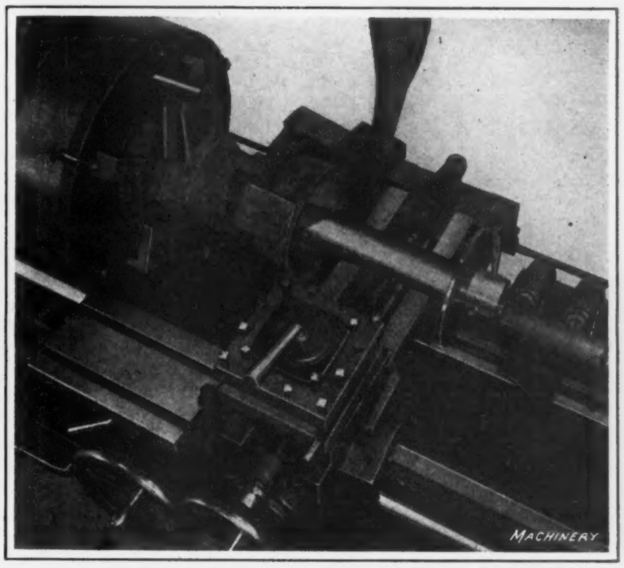


Fig. 9. Method of holding Work in Second Operation

Fig. 19 shows the layout of the tooling equipment for the first operation, and Fig. 20, the equipment for the second operation; the illustration Fig. 21 indicates how the motor frame is held for the first operation, and Fig. 22 shows the method of holding for the second operation.

In the first operation, the work is carried out step by step as follows: (1) the work is held by special hard chuck jaws having clamping screws as indicated in Figs. 19 and 21. (2) Surfaces *B* and *C* are rough-bored by tool *O* in the toolpost. (3) Surfaces *D*, *E*, and *F* are rough-turned and faced by tool *P* in the toolpost. (4) The outside of the housing at *G* is rough-turned with tool *R* held in the wing-rest. (5) The outside *G* is finish-turned with tool *S* held in the wing-rest. (6) The hole *A* is rough- and finish-bored with cutters held in the boring-bar mounted in Side 1 of the turret. The end of this bar is piloted in the bushing shown in Fig. 19 in the chuck. (7) A second roughing cut is taken on surfaces *B*, *C*, *D*, and *E* with cutters held in the head mounted in Side 2 of the turret. (8) Surfaces *B*, *C*, *D*, *E*, and *F* are finish-turned with cutters held in the head mounted in Side 5 of the turret. It will be noted that both the head mounted in Side 2 and that mounted in Side 5 of the turret are provided with a pilot which enters the bushing in the chuck and also with a collar or bushing which fits the bore *A*. This arrangement insures concentricity of all the finished surfaces. The total time required for the first operation is 35 minutes.

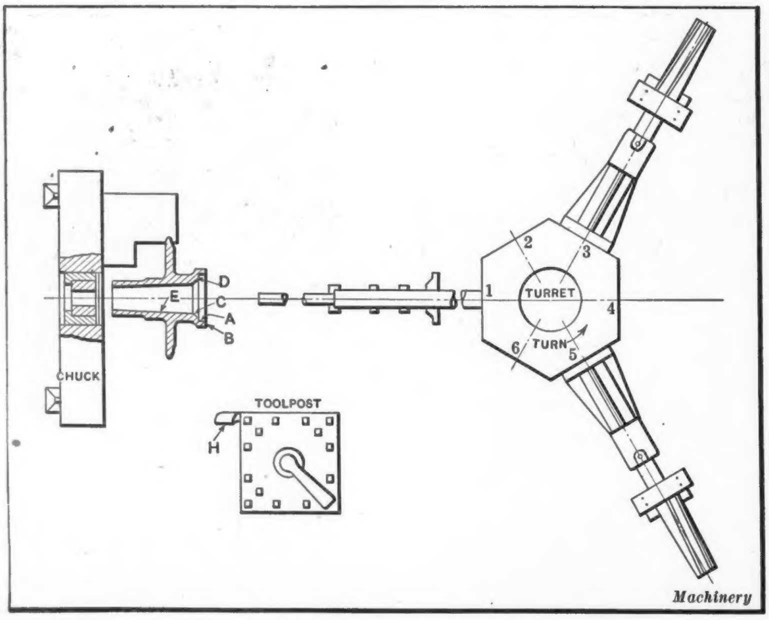


Fig. 10. Tooling Equipment for First Operation on Wheel Hub

For the second operation, the work is held on a special chuck plate as indicated in Figs. 20 and 22, clamps holding it tightly to the plate. The step-by-step operations are as follows: (1) The motor frame is centered on the chuck plate and the clamps are tightened. (2) Surfaces *I*, *J*, and *K* are rough-machined with tool *T* in the toolpost. (3) The outside surface *H* of the motor frame is turned with tool *U* in the wing-rest. (4) The bore *L* is started with tool *V* held

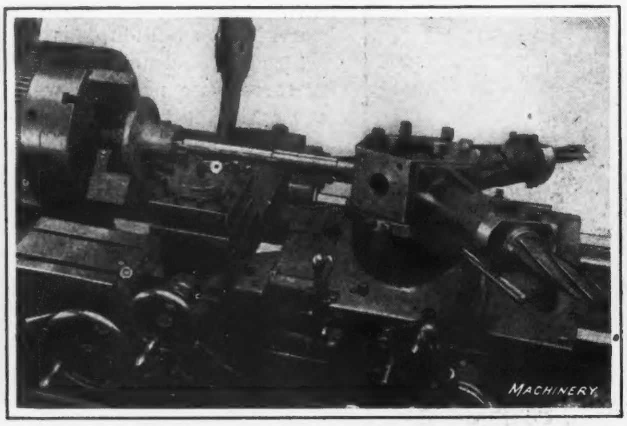


Fig. 11. Machine set up for performing First Operation on Wheel Hub

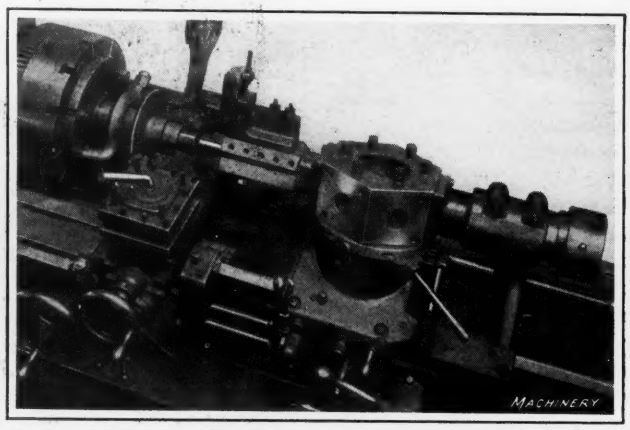


Fig. 12. Machine set up for performing Second Operation on Wheel Hub

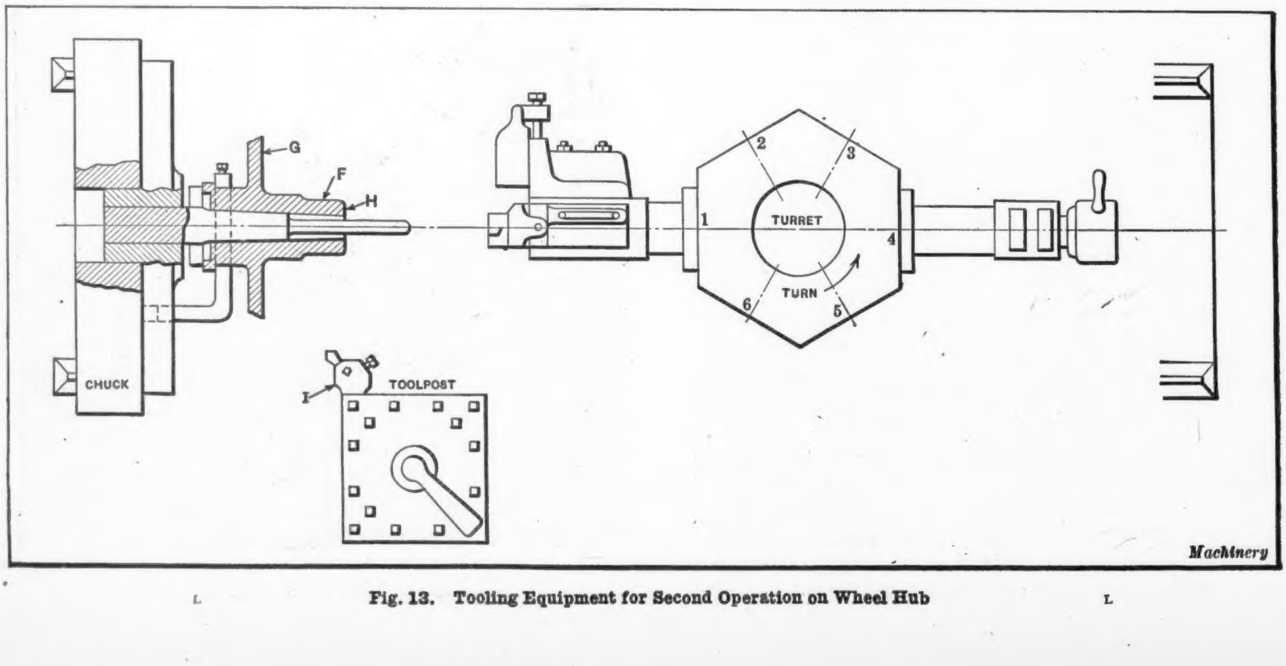


Fig. 13. Tooling Equipment for Second Operation on Wheel Hub

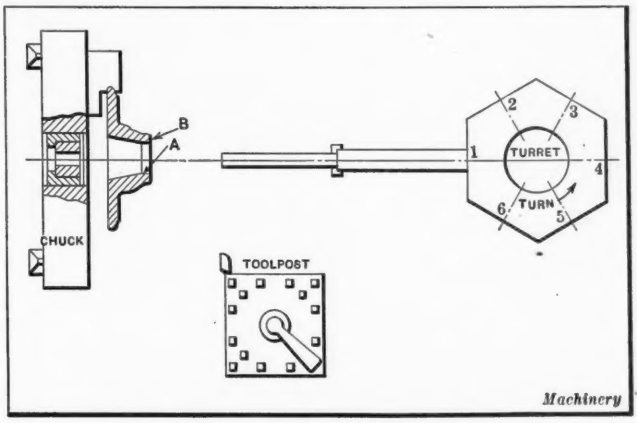


Fig. 14. Tooling Equipment for Another Hub Part

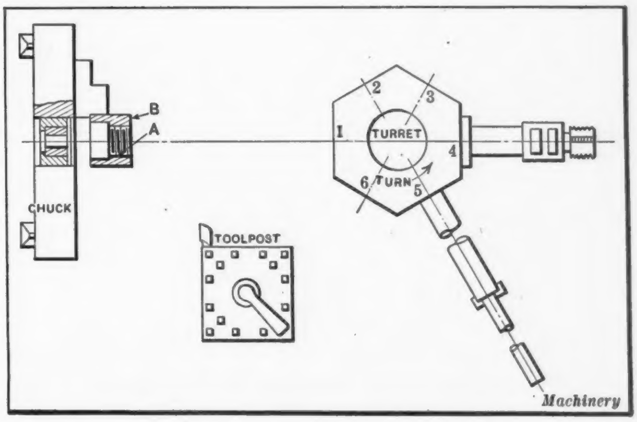


Fig. 15. Tooling Equipment for Hub-point Band

in the toolpost. (5) The hole *L* is rough-bored with cutters held in a boring head mounted in Side 1 of the turret. (6) Hole *L* is finish-bored with cutters held in the boring head mounted in Side 4 of the turret. Both heads referred to are guided by a pilot entering a bushing mounted in the chuck

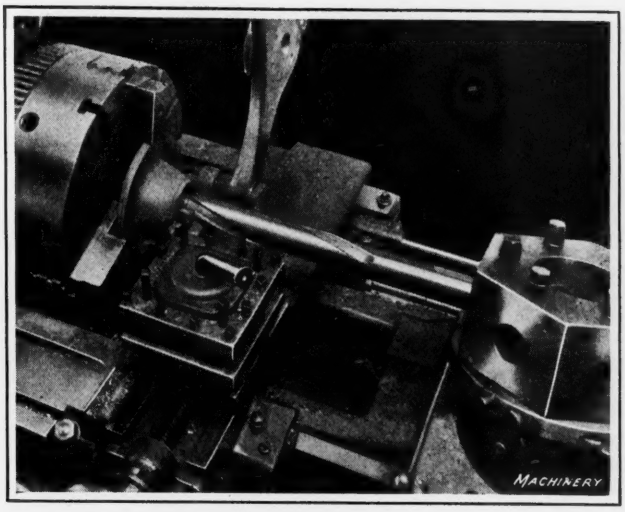


Fig. 16. Machine set up for performing Operation on Part shown in Fig. 14

plate as indicated in Fig. 20. (7) Surfaces *I*, *J*, and *K* are rough-turned with cutters held in the head mounted in Side 2 of the turret. (8) The same surfaces are finished with cutters held in the head mounted in Side 5 of the turret. (9) The shoulders *M* and *N* are finished with tool *W* held in the toolpost. (10) The outside surface *H* of the motor frame is finish-turned with tool *X* held in the wing-rest. The total time required for the various steps in the second operation is 45 minutes.

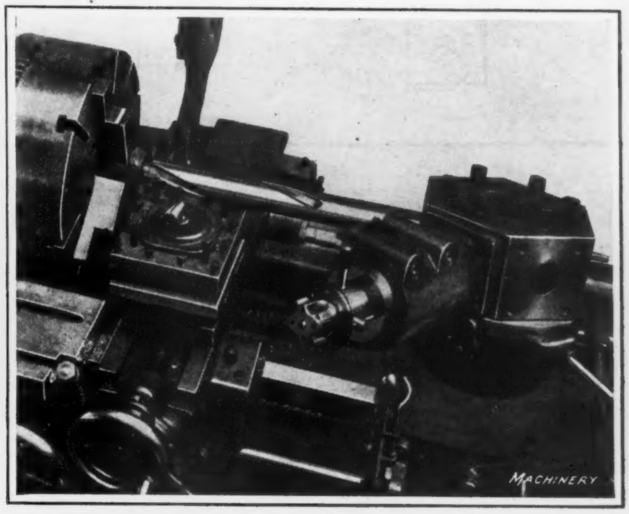


Fig. 17. Machine set up for performing Operation on Part shown in Fig. 15

A motor frame of somewhat different construction is shown in Fig. 24, where the tooling lay-out for the first operation on a 24-inch Gisholt turret lathe is also illustrated. The tool lay-out for the second operation on this motor housing

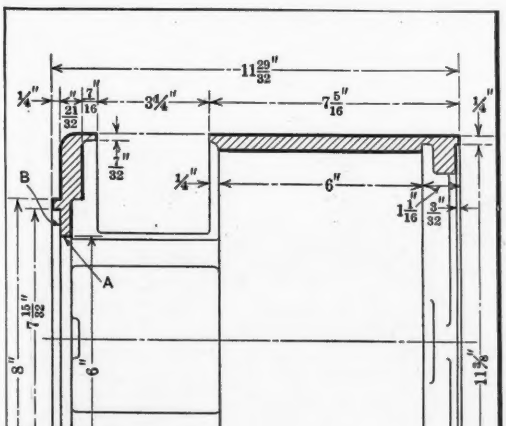


Fig. 18. Motor Frame machined on Turret Lathe

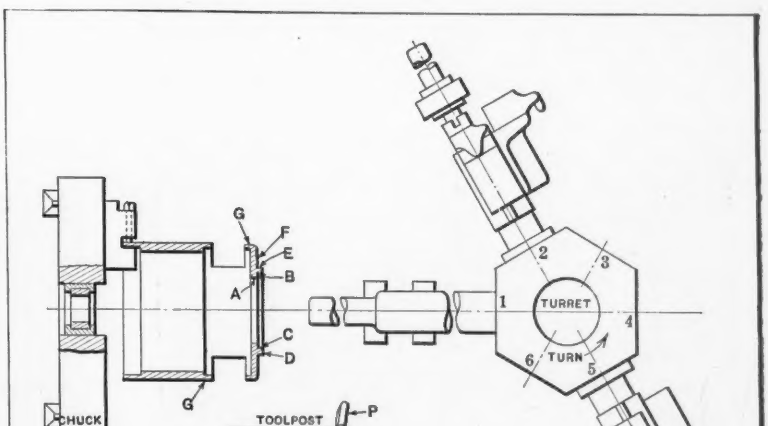


Fig. 19. Tooling Equipment for First Operation on Motor Frame

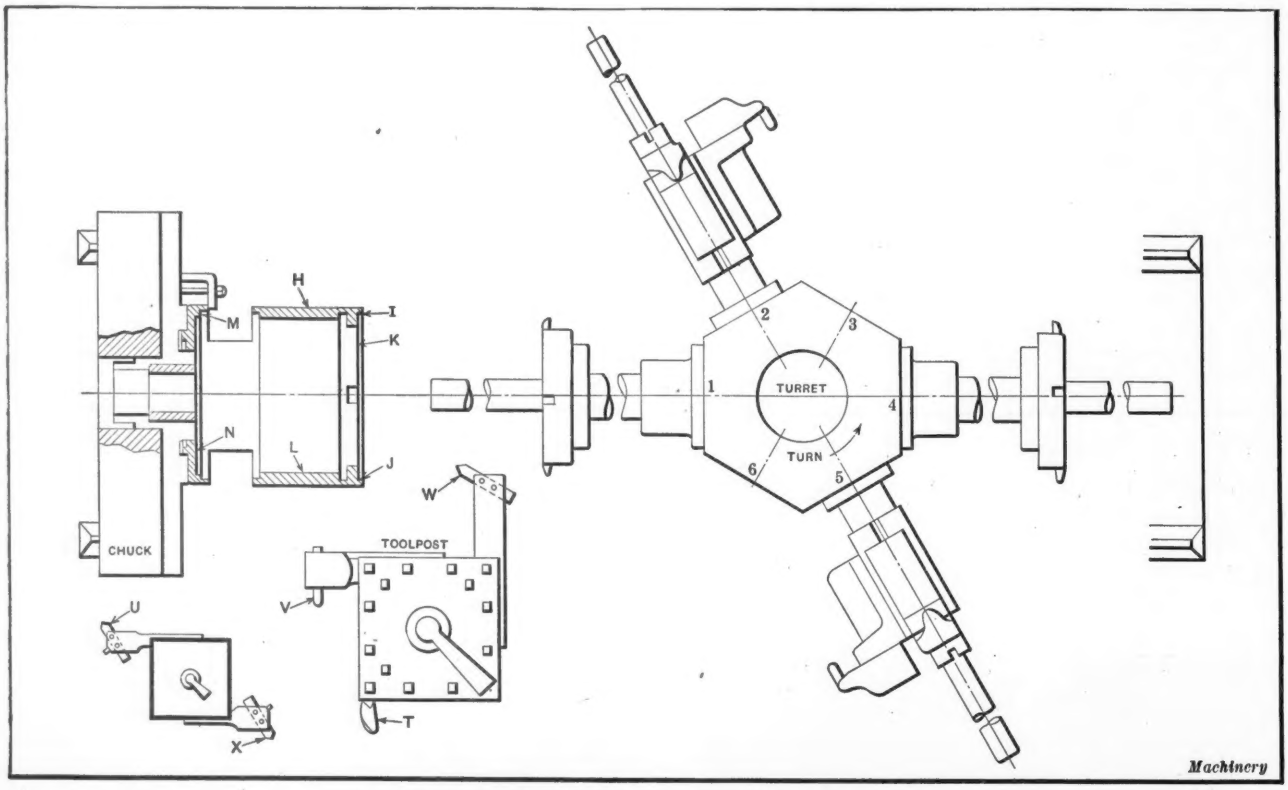


Fig. 20. Tooling Equipment for Second Operation on Motor Frame

is shown in Fig. 27, while Figs. 25 and 26 show the method of holding the work for the first and second operations, respectively. The housing is of cast steel the same as in the previous case, and the method of machining is similar, the various steps for the first operation being, briefly, as follows: (1) The work is held with special hard jaws and clamping screws. (2) Surfaces *B*, *C*, *E*, and *F*, Fig. 24, are rough-machined with tool *K* held in the toolpost. (3) The outside of the motor frame is rough-turned up to the chuck jaws, as indicated at *D* and as shown in Fig. 25, by tool *L* held in the wing-rest. (4) The hole *A* is finish-bored by cutters held in the boring-bar mounted in Side 1 of the turret. This bar is provided with a pilot entering the bushing in the chuck. (5) Surfaces *B* and *C* are rough-faced with cutters held in the head mounted in Side 2 of the turret. The pilot on the end of this tool enters the bushing in the chuck, and a bushing on the pilot also enters the bore *A* so as to insure concentricity of the machined surfaces. (6) Surface *F* is faced with tool *M* in the toolpost. (7) Surfaces *B*, *C*, and *E* are finished with cutters held in the head mounted in Side 5 of the turret. This head is guided with a pilot and a bushing in the same manner as the head mounted in Side 2 of the turret. (8) The outside surface *D* is finished with tool *N* in the wing-rest. The first operation takes 55 minutes.

In the second operation, the work is held by means of a special chuck plate and clamps, most clearly shown in Fig. 26, the detailed operations being as follows: (1) The motor frame is centered on the chuck plate and the clamps are tightened. (2) Surface *B*, Fig. 27, is rough-faced with tool *O* in the toolpost. (3) The outside of the motor frame is rough-turned at *C* with tool *R* in the wing-rest. (4) Holes *A* and *D* are rough-bored with cutters held in the boring heads mounted in Side 1 of the turret. (5) The same holes are finish-bored with cutters held in the boring heads mounted in Side 4 of the turret. In both of these cases, pilots are provided on the ends of the boring-bars entering bushing *S* in the chuck plate. (6) Surface *B* is finish-faced with tool *T* in the toolpost. (7) The outside of the motor housing at *C* is finish-turned with tool *U* in the wing-rest. The total time required for the steps in the second operation is 55 minutes.

Machining a Frail Part in the Turret Lathe

Fig. 23 shows an example of a frail part that is machined in the turret lathe. This part is an armature mounting

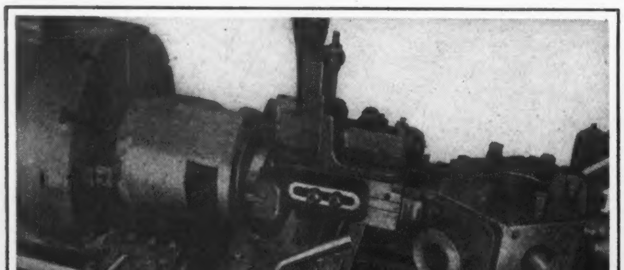


Fig. 21. Detail View showing how Motor Frame is held for the First Operation

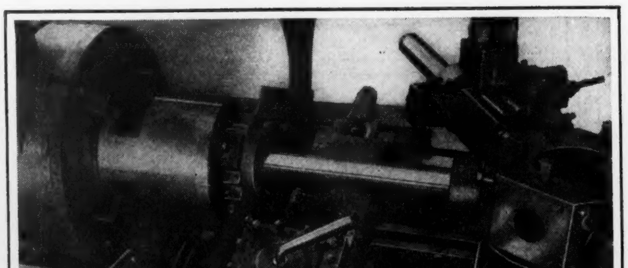


Fig. 22. Detail View showing how Motor Frame is held for Second Operation

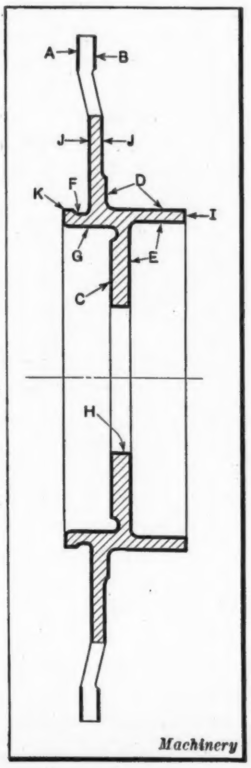


Fig. 23. Armature Part

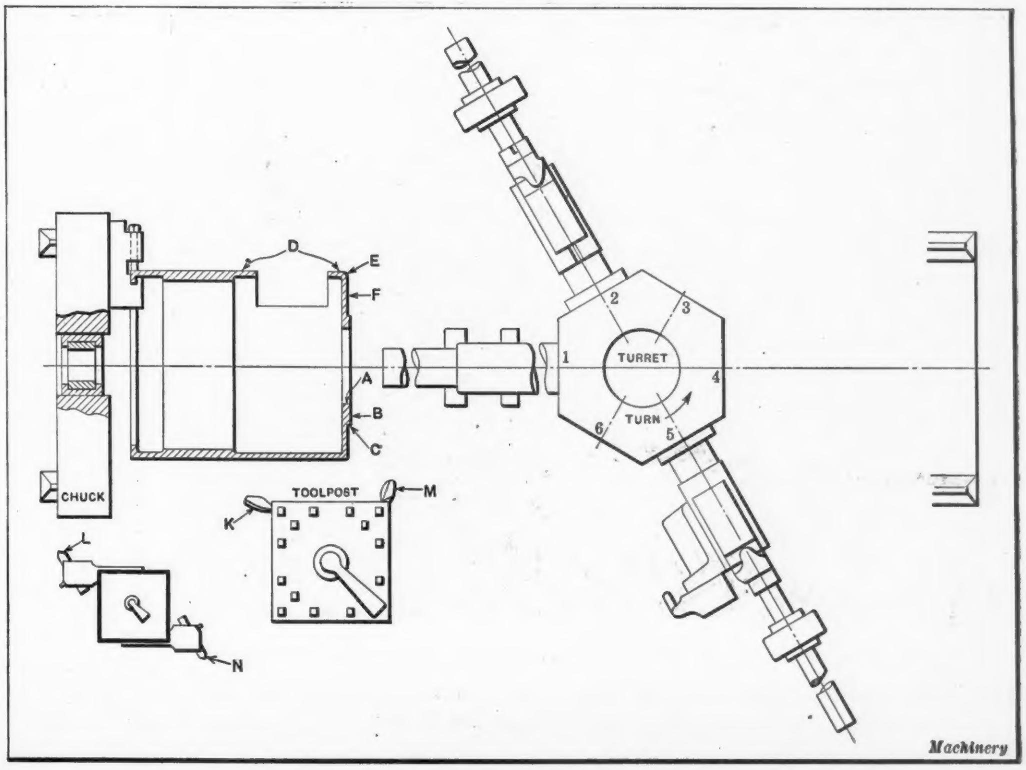


Fig. 24. Tooling Equipment for First Operation on Motor Frame of the Type shown

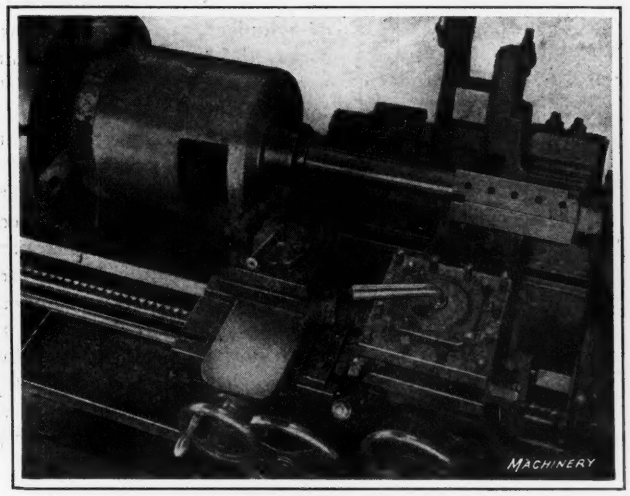


Fig. 25. Method of holding Motor Frame (Fig. 24) for First Operation

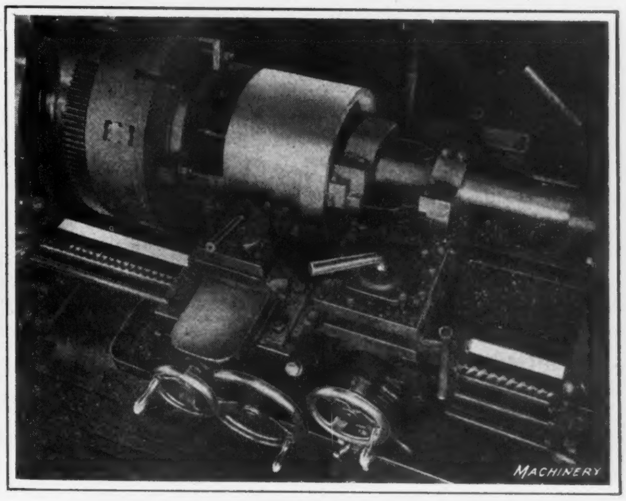


Fig. 26. Method of holding Frame for Second Operation

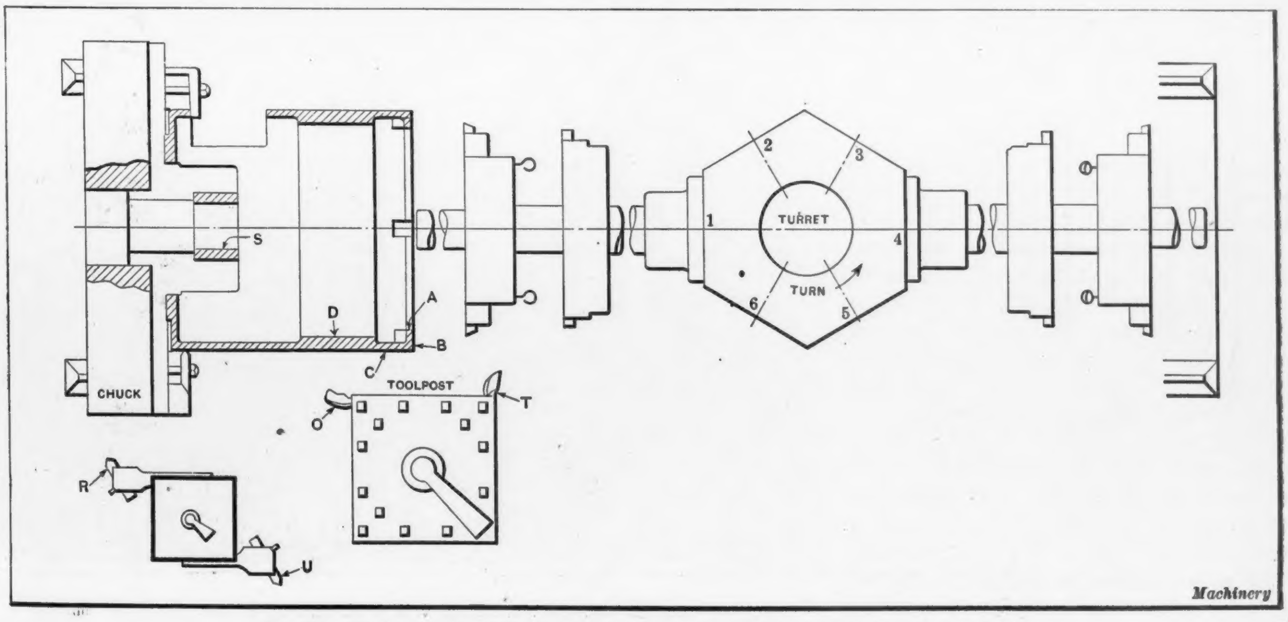


Fig. 27. Tooling Equipment for Second Operation on Motor Frame shown in Fig. 24

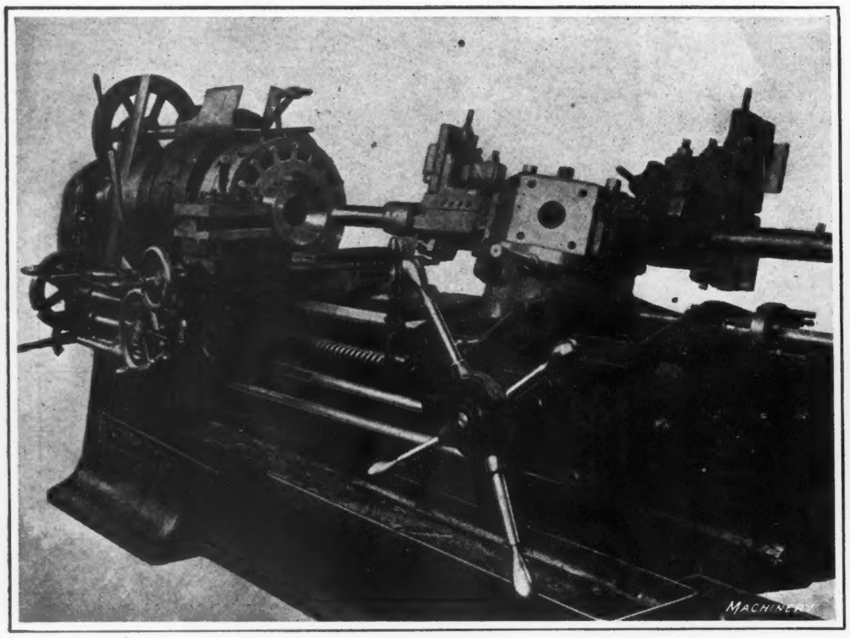


Fig. 28. View showing Method of holding a Frail Part for machining on Turret Lathe

machined on a 21-inch Gisholt turret lathe in two operations. Fig. 28 shows the method by which the work is held in the turret lathe, a special chuck being provided with pin or stud supports for each of the projecting prongs of the armature mounting. Chuck jaws on the inside grip the part, these jaws being more clearly shown in Fig. 30, where the piece is removed from the chuck and where the supporting studs or pins may also be seen. The greatest interest in this operation is attached to the method of holding and supporting the frail part, the actual operations performed upon the part being similar to those already described and consisting of the usual turning, boring, and facing operations for which both the toolpost tools and the heads in the turret are used, and which therefore requires no further explanation.

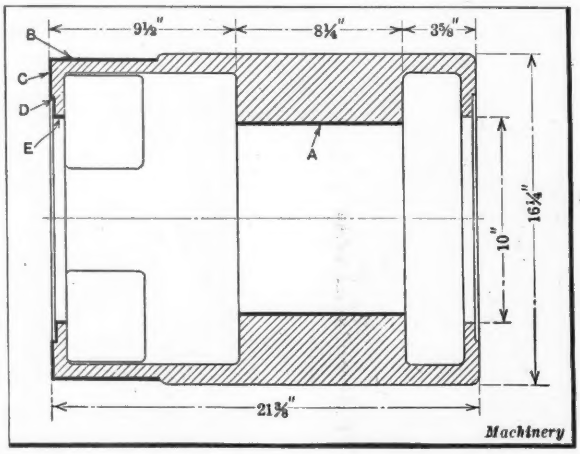


Fig. 29. Heavy Piece machined on Turret Lathe

Machining Very Heavy Work

Fig. 29 shows a very large piece weighing over 600 pounds, made from cast steel, that is machined on a 28-inch Gisholt turret lathe, and which shows the possibilities for handling heavy work on this class of machine, and also illustrates the possibilities for using multiple tools or combination sets of tools for boring different sizes of holes in the work. Fig. 33 shows the tool lay-out for the first operation. As indicated in this illustration, and as also shown in Fig. 31, a special fixture is used for supporting the casting. This is of the so-called "bonnet" type, which gives a support to the casting a considerable distance from its end. Figs. 31 and 32 also show the type of multiple tool-heads employed for boring the three different diameter holes in the casting. The work is carried out step by step as follows: (1) The end *C*, Fig. 33, is faced with a tool held in the toolpost. (2) The holes *A* and *E* are rough-bored and the counterbore *D* is rough-machined with the multiple tool-heads held in the turret. The bar on which these heads are held is guided by the bushing in the chuck. At the same time as the casting is rough-bored, the outside *B* of the casting is rough-turned with the tool held in the toolpost. (3) The outside *B* of the casting is finish-turned with a tool held in the toolpost. (4) The holes *A* and *E* and the counterbore *D* are finished with the multiple cutter-heads mounted in the turret.

In the second operation, the casting is held on a chuck plate provided with clamps, as is clearly shown in Fig. 34. The work, when located on the chuck plate and clamped in position, is shown in Fig. 35. The second operation consists in facing the end of the casting with a tool held in the toolpost, and boring and counterboring the work at the end by means of a two-head boring-bar as shown in Fig. 35. The total time required for finishing this casting, including both the first and second operations, is 70 minutes.

The article in the December number of MACHINERY will deal in the same detailed manner as the first two articles with the tooling equipment and the order of operation for the machining of cylinders, piston rings, clutch cones, and a number of miscellaneous parts. In connection with the machining of these miscellaneous parts, it will be pointed out how turret lathes that sometimes cannot be kept fully busy on the work for which they have been procured, can be used to advantage for other work for which the machine might not have been purchased if there had been no other work to do on the machine, but which, when the machine is available, can be performed on the turret lathe more rapidly, and therefore more cheaply, than on other machine tools.

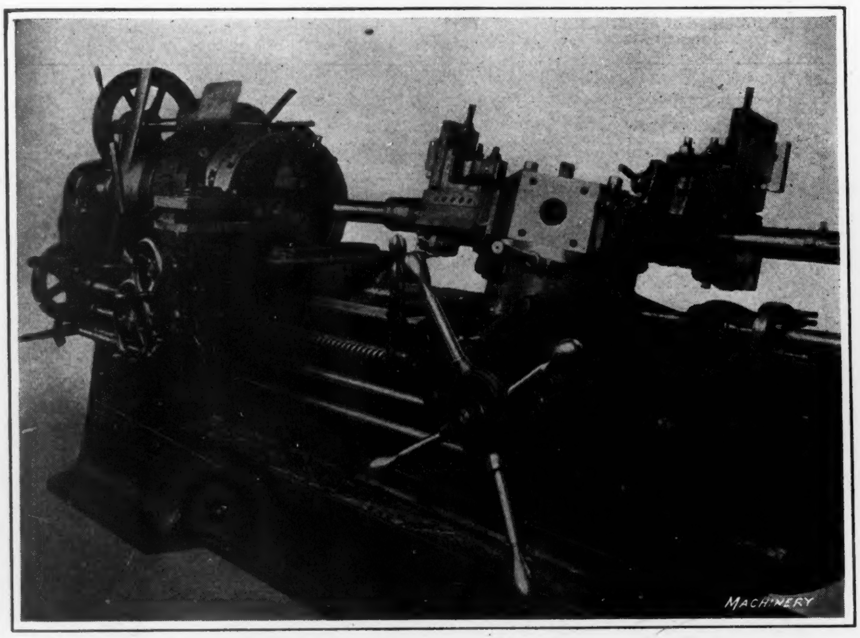


Fig. 30. Machine illustrated in Fig. 28 with Work removed to show Method of holding

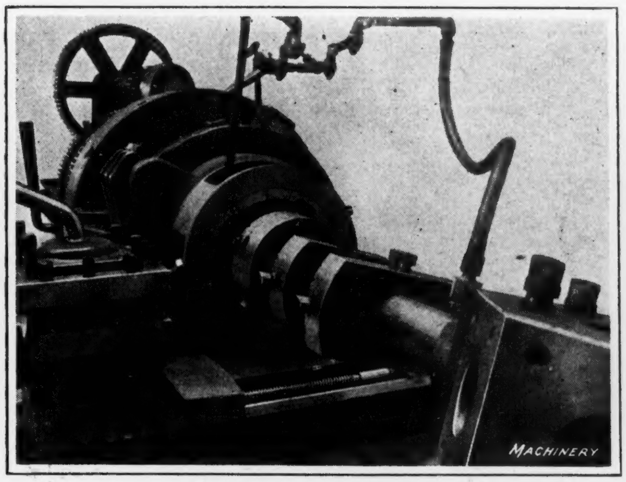


Fig. 31. Special Fixture of the Bonnet Type for holding Heavy Work shown in Fig. 29

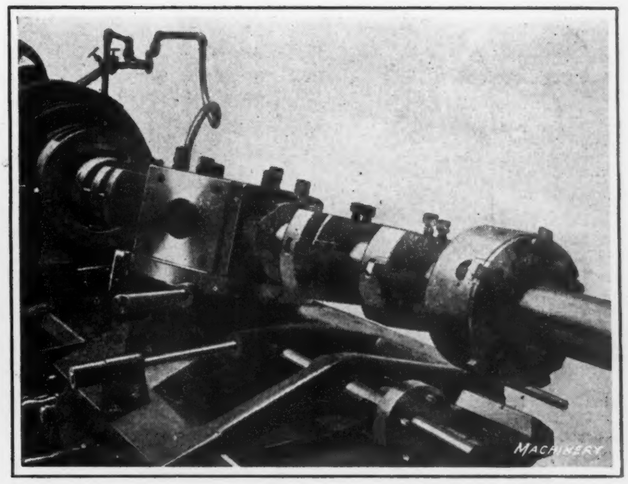


Fig. 32. Fixture and Multiple Tool-head used in machining Work shown in Fig. 29

IMPORTANCE OF THE DEVELOPMENT OF CHEMICAL INDUSTRIES IN THE UNITED STATES

Germany had the leadership in chemistry and we have got to take it away from that country, and we can only do that by developing along lines that have been developed only in Germany on a large scale. We must have something like the chemists—not primarily engineers, but men who are able to apply all the great principles of science directly to the problem of the moment, as has been done by many during the war. Every university in America is capable of producing men of that kind, but there are very few that have anything more than a machine standard in their college. You have got

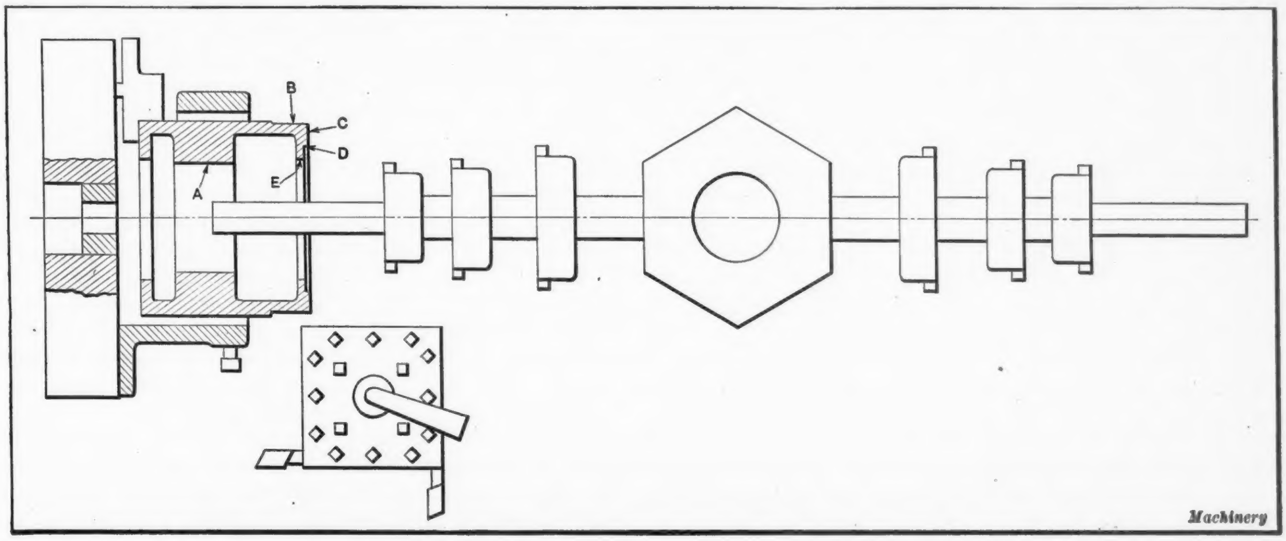


Fig. 33. Tooling Equipment for First Operation on Heavy Casting shown in Fig. 29

German relationship between the universities and the industries, and chemistry in particular is a subject where it is not enough to be a trained and experienced applier of science. The country, if it is to be safe industrially and if it is to have the leadership intellectually in chemistry, has got to have a great number of men who are primarily scientific to produce a man who is scientifically and intellectually an individualist, who has independent judgment and power. Such a man can be the product only of an institution or of a group of men who can give him something more than most colleges give, unless he is big enough to make himself.—*Professor L. J. Henderson, Harvard University.*

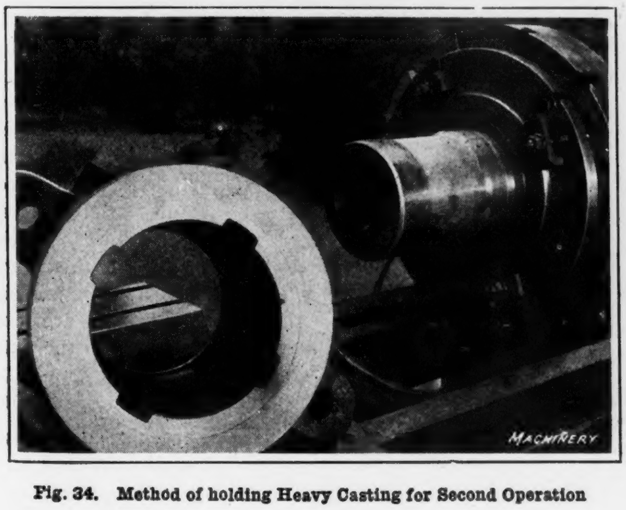


Fig. 34. Method of holding Heavy Casting for Second Operation

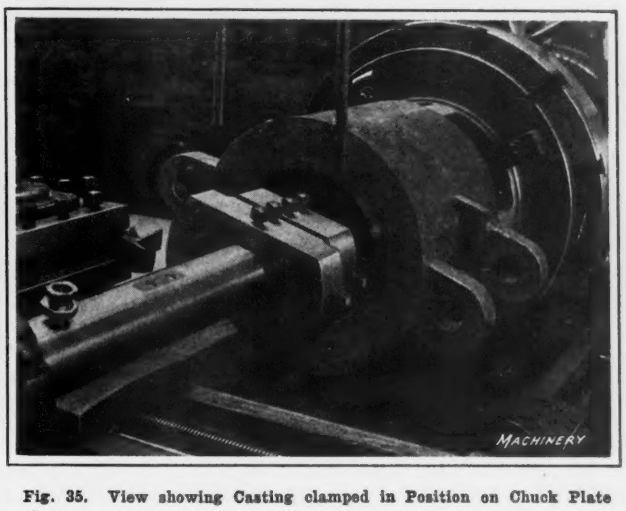
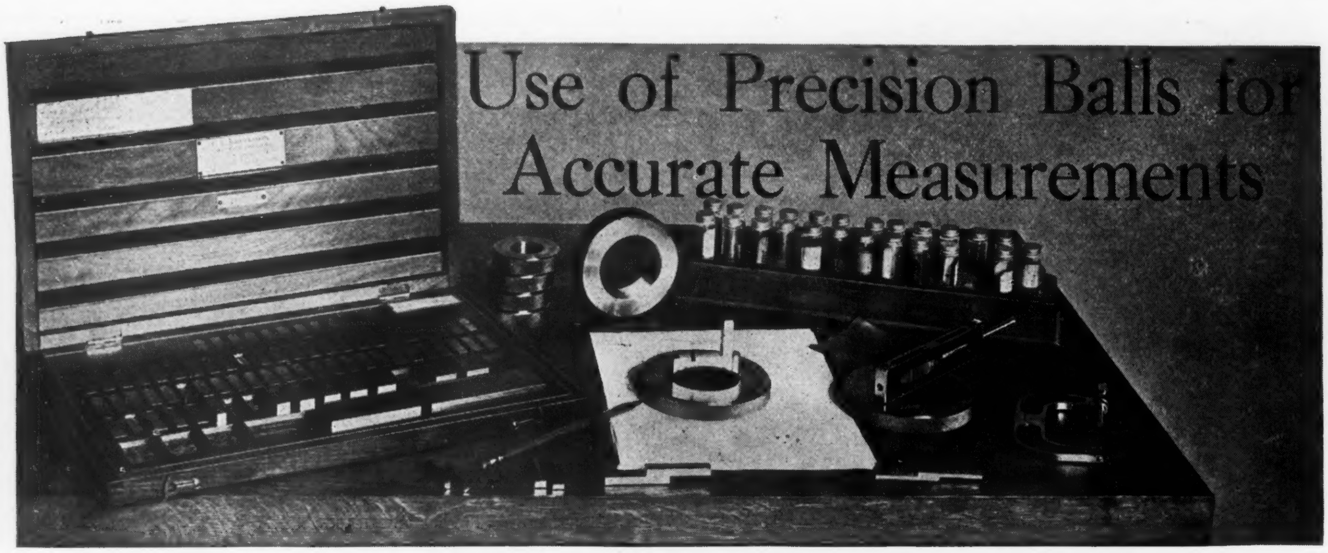


Fig. 35. View showing Casting clamped in Position on Chuck Plate



Use of Precision Balls for Accurate Measurements

A Detailed Explanation of the Application of Steel Balls for Precision Measurements in Shop Work

By R. L. RANKIN, Assistant Physicist, Bureau of Standards, Washington, D. C.

PRECISION balls are used in the Gage Section of the Bureau of Standards as attachments for machines and for taking direct measurements in the inspection of gages. While their application to work of this nature is not so general as that of some other accessories, yet they are indispensable, in certain cases, for obtaining accurate measurements. Fig. 1 shows a case of precision balls ranging from 1/16 inch to 4 inches in diameter, these balls being considerably more accurate than ordinary commercial steel balls. Prior to their use, the balls were carefully measured and cards showing the *rated* diameter of each ball, together with the *actual* measurement, were placed in the case. These measurements showed that the rated diameters were accurate to within a few hundred-thousandths inch.

Application of Balls on Measuring Machines

Fig. 2 shows three brass thimbles, in each of which a ball has been mounted, for use as contacts on measuring machines in order to obtain more accurate measurements of flat-end standards or measuring rods, gages and other exact work. These balls are so mounted that they extend, both inside and outside, beyond the wall of the thimble, thus allowing them to make contact with both the part being measured and the spindle of the measuring machine when the thimbles are being used as illustrated in Fig. 3. The sum of the diameters of the two balls is subtracted from the reading which is obtained, in order to calculate the actual length measurement. The balls may be mounted either concentrically or eccentrically in the thimbles. Two thimbles having the balls located concentrically are used for measuring the length of a gage, and thimbles having the balls located eccentrically are used when further data are desired, such as the parallelism of the faces of a gage. In two of the thimbles shown in Fig. 2, the balls are located eccentrically, and in the other thimble the ball is placed in the center.

Two balls mounted in thimbles, in use on a Pratt & Whitney machine for measuring the length of a flat-end standard, are shown in Fig. 3. The object in using a pair of concentrically mounted ball contacts in determining the length of a flat-end standard is to reduce errors due to poor alignment of the standard when placed in a measuring machine. While flat-end standards up to 6 inches in length can be brought into good contact with both the anvil and the spindle of a machine, it is difficult to secure good alignment of standards of greater length. Consequently, readings frequently are recorded which are 0.001 inch greater than the actual length of the standard, and it is almost impossible to be sure when the minimum or true reading has been obtained. However, errors are largely eliminated by the use of ball contacts. For example; if a true 12-inch end-standard having flat faces 3/8 inch in diameter is out of alignment enough to give a reading on the measuring machine of 12.00094 inches when no ball contacts are used, the reading with the standard in the same position will be 12.00005 inches when 1/8-inch diameter ball contacts are used, thus reducing the observed error from 0.00094 to 0.00005 inch.

While concentrically mounted balls are sufficient in most cases for taking length measurements such as just described, it is sometimes convenient to use eccentrically mounted balls when the lathe center holes have not been removed, or when the gaging surfaces of some other type of gage are not in line with each other—that is, offset relative to the axis of the machine. Eccentrically mounted balls are also useful when it is desired to determine just how the gage is aligned so that the small errors observed even when concentric ball contacts are used can be still further reduced. They are also used to determine whether the faces of a flat-end standard are parallel and if they are perpendicular to the axis.

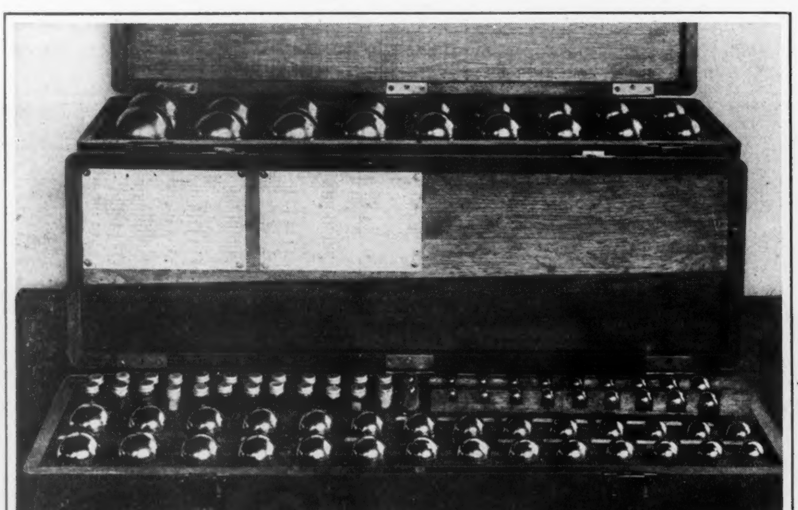


Fig. 1. Case of Precision Balls ranging from 1/16 Inch to 4 Inches in Diameter

Method of Using Eccentrically Mounted Balls

A gage which is out of alignment after having been placed on a

machine is illustrated by the diagrammatic sketch *A*, Fig. 4. It is not possible except in exaggerated cases, to tell by means of the eye that a gage is out of alignment. In order to determine this fact, the left-hand ball in the illustration is turned around into different positions until the minimum reading is obtained on the machine; it is retained in this position while the right-hand ball is turned around until the maximum reading is obtained. It is found that in such cases the two balls will be opposite each other; that is, both balls will be either at the top of the gage, at the same side, or at the bottom, if the variation in the readings is due to poor alignment of the gage. If the gage is revolved 180 degrees so that the portion of the gage which was formerly at the top is at the bottom, the minimum reading is still obtained at the top on the left-hand end, and the maximum reading at the top on the right-hand end, provided the alignment of the gage is not disturbed when revolving it. By adjusting the position of the gage, it is possible to reduce the difference between the maximum and the minimum readings that are found when each ball is revolved, until the gage is finally in good alignment.

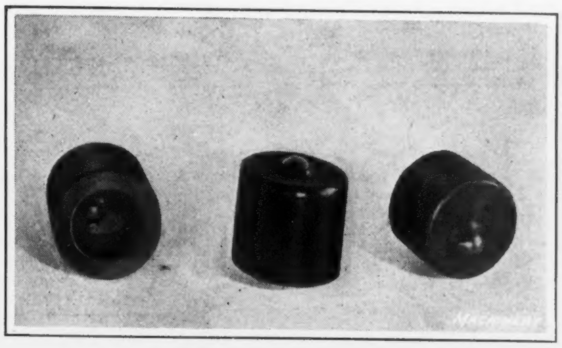


Fig. 2. Balls mounted in Thimbles for Use on Measuring Machine

The faces of the gage illustrated at *B* in Fig. 4, are not perpendicular to the axis of the gage. After the ball at one end is placed in such a position that the minimum reading is obtained and the other ball is placed so that the maximum reading is obtained, results similar to those produced in the preceding case when the gage was out of alignment may be observed, but with this difference: when the faces of a gage are not perpendicular to its axis, the maximum and the minimum readings on both ends revolve with the gage. Thus, if the gage which is illustrated is turned around 180 degrees the minimum and maximum readings will then be at the bottom of the gage, at the same ends, respectively, as they were before the gage was turned.

The most important application of eccentrically mounted ball contacts is in the determination of the parallelism of the contact faces of a gage. If a true flat-end standard is in perfect alignment, the observed length of the gage is the same for every position of each ball, and in the two previous cases the balls were opposite each other when the minimum reading was obtained at one end and the maximum reading at the other. However, when the faces of a gage are not parallel, the balls will not be opposite each other when they are placed in positions which will give the minimum and maximum readings on opposite ends of the gage. They may even be in line when each ball is adjusted for a minimum reading, as shown at *C* in Fig. 4. This occurs when the lack of parallelism is due to the gage being bent or warped. In any case, if the balls are not opposite each other when they are adjusted to give the maximum and the minimum readings, respectively, the faces of the gage are not parallel. The same thing is true if the readings change when one ball, but not the other, is revolved. Because the faces of a gage are not both perpendicular to the axis when they are not parallel, the maximum and minimum readings, at one end at least, revolve with the gage when it is turned around.

Comparator Used for Testing Long End-Standards

A seven-foot comparator which was made by the Bureau of Standards for its own use is shown in Fig. 5. It consists of a 7-foot piece of railroad rail which was scraped flat on the top, a number of holders for the end-standards, some mounted balls, an indicator mounted at one end of the rail, and a micrometer mounted at the other end. This comparator is used to measure the length of end-standards which are longer than the standards of known length commonly used for direct comparison with standards that are to be measured. In using the comparator, the standard being measured is compared with the combined length of several shorter flat-end standards, these standards of known length being placed in the comparator as shown in the illustration, so that their combined length plus the diameters of the balls which are mounted in the holders, will be about equal to that of the standard to be measured. The micrometer at the left end of the device is set so that the indicator at the other end reads zero, after which the short standards are replaced by the standard to be measured and the indicator reading is again brought to zero. The length of the standard is obtained by adding the lengths of the short end-standards to the diameters of the balls, and then adding to or subtracting from this sum the difference between the two micrometer readings. It is necessary to have the balls between the micrometer spindle and the first standard, and between the faces of the standards, in order to obviate errors due to

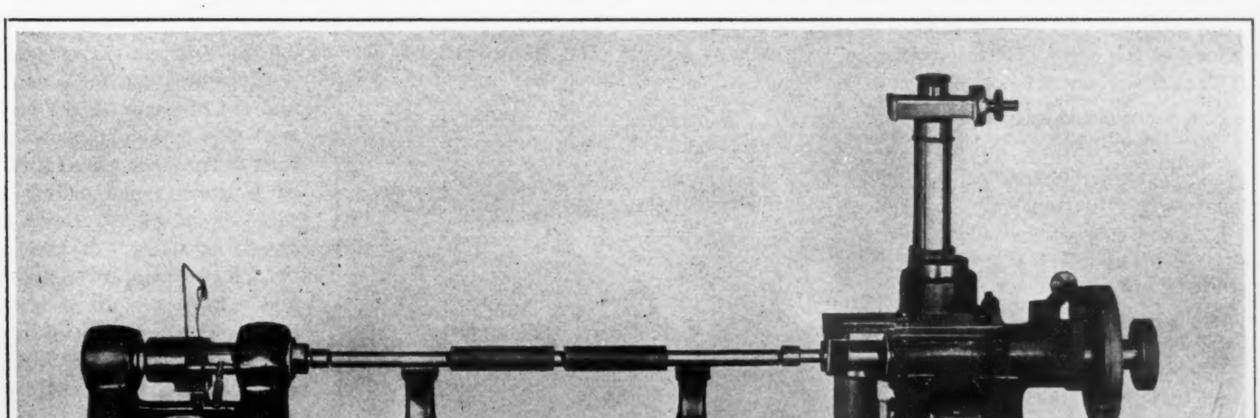


Fig. 3. Pratt & Whitney Measuring Machine in which Ball-contact Thimbles are used

imperfect alignment of the standards. This comparator is simple in construction and operation, and is suitable for use in manufacturing plants.

Use of Balls for Testing Micrometers

A pair of balls, mounted as shown in Fig. 6, is useful for testing the parallelism of the contact faces of ½- and 1-inch micrometers. In doing this, the micrometer is set so that when one of the balls is slid in and out between the spindle and anvil it will barely make contact between the high points. A reading is taken and the micrometer is then adjusted so that the ball will just enter at the low point, after which this micrometer reading is also taken. The difference between these readings is the approximate amount that the faces of the anvil and spindle are out of parallelism.

This test is so sensitive that, by supplementing it with two other simple tests, the parallelism of micrometer caliper faces can be determined to within 0.00001 inch, if some means are provided for reading a movement of the micrometer screw of this magnitude. One of these additional tests consists of determining the character of the surfaces of the anvil and the spindle by means of the optical flatness test, which is necessary because the difference in the readings may be due partially to the unevenness of the contact surfaces. The other additional test is a repetition of the first test but with a ball having a different diameter. This test is made because the micrometer faces may be parallel for one position of the spindle and not parallel for other positions, due to the fact that they are not lapped perpendicular to the axis of the screw. For convenience, two balls of different sizes are mounted at opposite ends of the same holder.

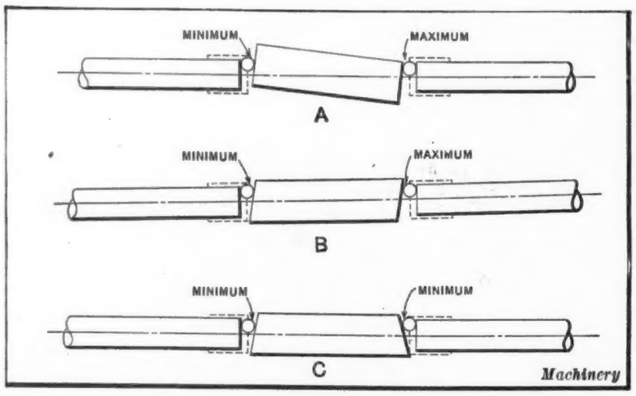


Fig. 4. Diagrammatical Sketches illustrating Use of Eccentrically Mounted Balls

The following formula is used to solve the angle of taper:

$$\text{Sin } a = \frac{(R - r)}{(m - M) - (R - r)}$$

in which

a = one-half the included angle of taper;
R = radius of large ball;
r = radius of small ball;
M = measurement taken to top of large ball;
m = measurement taken to top of small ball.

The diameter of the hole at the large and small ends of the gage may be readily determined after the angle of taper is known. The formula for finding the diameter D at the large end is as follows:

$$D = 2 \sec a \, [R + \sin a \, (M + R)]$$

Precision balls are also used in measuring the effective or pitch diameter of threaded ring gages. The method of taking these measurements is analogous to the three-wire method of measuring the effective diameter of threaded plugs, the diameter of the balls being the same as that of the wires used for measuring a plug of the same thread pitch. While the results obtained by this method are somewhat uncertain, due to the great compression of the balls caused by a comparatively light pressure, it can be used in case no check plug accompanies a ring gage.

Other applications of precision balls will suggest themselves to the inspector, but some of the most important are outlined above. Balls of all the sizes shown in Fig. 1 are not usually necessary, but a set of balls ranging by eighths of an inch from ¼ to 1¼ inches in diameter, is very useful.

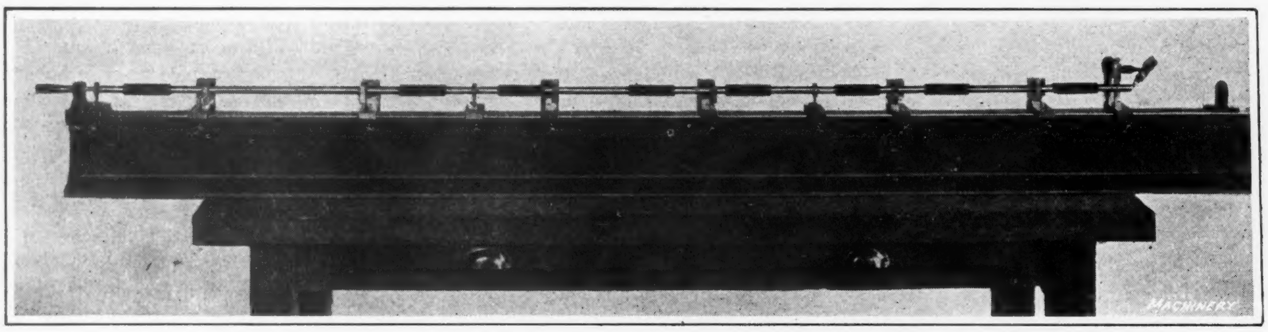


Fig. 5. Comparator built by the Bureau of Standards for measuring Extra Long Flat-end Standards

Use of Balls in Measuring Gages

The most satisfactory method for measuring the taper of small-diameter ring gages is by balls, as illustrated in Fig. 7. Two balls are selected, one of which will fit near the small end of the hole and the other near the large end. Readings are then taken by means of an indicator or a depth micrometer, to find the distance from the top of the gage to the top of each ball. When care is taken not to force the balls into the hole, very accurate determinations of the taper may be computed from these measurements.

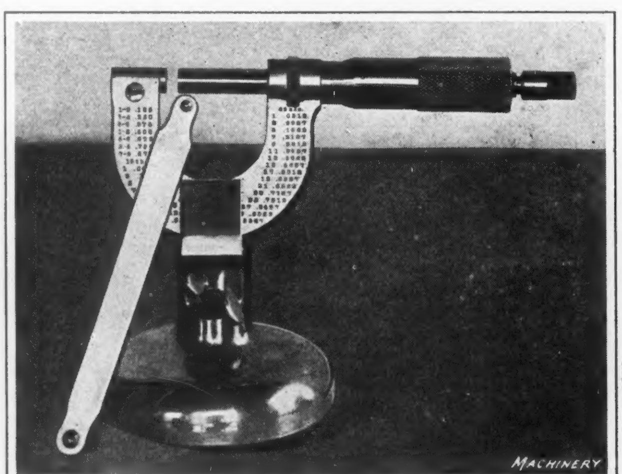


Fig. 6. Mounted Balls for ascertaining the Parallelism of the Faces of Micrometer Spindles and Anvils

* * *

The Monthly Labor Review of the Department of Labor shows that during the year 1918 there occurred 3181 strikes and 104 lock-outs in the country. The principal causes for the strikes are summarized as follows: Demands for an increase of wages, 1352; decrease of hours, 79; increase of wages and decrease of hours, 248; recognition of the union, 186; recognition and wages, 95; recognition, wages, and working hours, 66; demand for discharge of foremen, 37; discharge of employes, 203; employment of non-union men, 61; sympathy strikes, 34; jurisdiction strikes, 16; general conditions, 54. The total duration of strikes in 1918 was 28,386 days; in 1917, 24,076 days.

INGENIOUS REPAIR JOB

By EDWIN J. BACHMAN

The writer, who is employed in a small repair shop, recently had occasion to repair a concrete mixer which did not operate properly. It was found that the source of trouble would be eliminated if a large sprocket on the engine crankshaft were replaced by a smaller one. The old sprocket had eighteen teeth and was a solid disk casting without spokes. As the new sprocket was to have only twelve teeth, it was decided to make it out of the old one. It was found that the radius of the space between the teeth beneath the pitch circle was 7/16 inch and that the circular pitch was 1½ inches. From these data the new pitch diameter was calculated and the pitch circumference laid out, after which twelve ⅞-inch equally spaced holes were drilled along the pitch circumference. The new sprocket was then turned down to the required outside diameter of the teeth, and a taper was turned on the sides of the teeth to permit them to enter the links of the chain readily. The excess metal between the teeth was then chipped out and filed to the desired shape. The correct contour of the teeth was obtained by the use of a sheet-iron templet. As the teeth had been cast on the original sprocket there was no necessity for great accuracy in machining the new one. A great saving in time was made by the method described, as it would have required more time to make a special milling cutter than is now necessary to do the whole job.

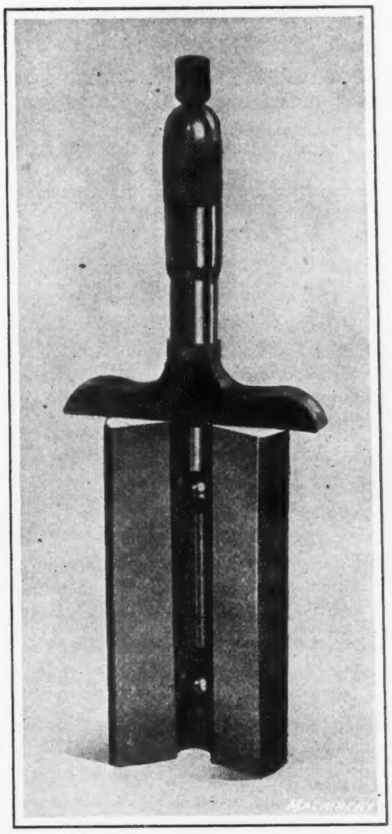


Fig. 7. Measuring the Taper Ring Gages by the Use of Precision Balls

* * *

INTERNAL CHAMFERING TOOL

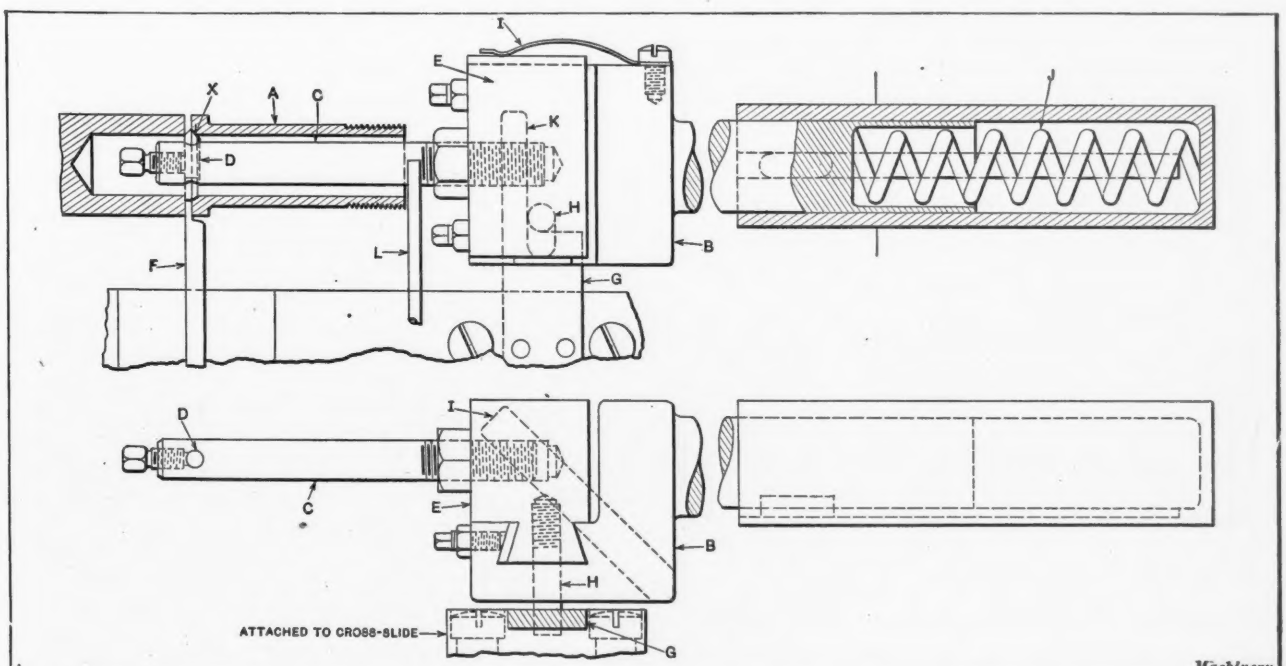
By R. A. MONTE

Nipples of the type shown at *A* in the accompanying illustration are frequently used on gas and oil engines and on other gas, oil, and hydraulic equipment. They are usually made of monel metal, bronze, or steel, and are frequently manufactured in large quantities on turret lathes. In most cases a second operation is required to produce the chamfer shown at *X*, but with the tool here described it is possible to perform this operation simultaneously with the cutting-off operation.

All the operating parts of the tool are carried in the body *B*, the shank of which telescopes into a sleeve which is held in the turret. The holder *C* in which the chamfering bit *D* is held is screwed into slide *E* and is prevented from turning by means of a lock-nut. Provision is made for adjusting the dovetailed tongue of the slide by means of a gib and adjusting screws. The cutting-off tool *F* is carried in a block on the cross-slide of the lathe. Pusher *G* is also secured to the cross-slide so that as tool *F* is fed into the work, *G* engages with a pin *H*, screwed into the under side of slide *E*, thus imparting a transverse movement to the slide and engaging the tool *D* with the work. The diameter of the chamfer is governed by the movement allowed the slide by the length of the slot in the body of the tool in which the pin *H* operates. At the same time that the cross-slide is being returned to its former position, after the work has been cut off, the slide *E*, actuated by the flat spring *I*, is returned to its normal position. The purpose of spring *J*, which is contained in the tool shank sleeve, is to absorb any shock that might be caused by sudden contact of the pin *H* with the finger *K* when advancing the tool into the work before starting the operation. The wire *L* is held against the nipple during the cutting-off operation in order to steady the work when it is nearly cut through. A saving in time of 15 per cent has resulted from the use of this device on large quantities of work.

* * *

The U. S. Training Service is devoting special attention to preparing courses in the proper methods of training in various industries so that interested manufacturers may be supplied with adequate material for operating training departments. The Training Service has issued several pamphlets on training, obtainable from the Department of Labor.



Tool used for performing an Internal Chamfering Operation

Stresses in Crankshafts

By VICTOR M. SUMMA, Examining Engineer, American Brake Co., St. Louis, Mo.

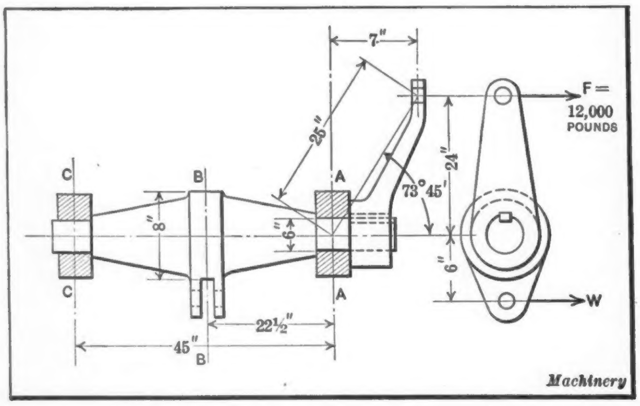


Fig. 1. Example of Crankshaft subjected to Stresses at Section B-B

IN Fig. 1 is shown a crankshaft of the same type as that described in the September number of MACHINERY in connection with stresses at section A–A. It is now required to ascertain the intensity of the stresses at the center of the shaft where the cross-sectional diameter is 8 inches. It is evident that the formulas used in determining the stresses at section A–A do not apply to section B–B nor to any section on the left of the reaction at bearing A–A. For determining the stresses at B–B, recourse must be had either to Rankine's fundamental equations or to their derivations for the equivalent bending and twisting moments. In the present case, we shall make use of the original formulas:

$$P_1 = 1/2\ (S + \sqrt{S^2 + 4S_s^2}) \text{ and } P_2 = 1/2\ \sqrt{S^2 + 4S_s^2} \quad (1)$$

The solution of the problem will be simplified somewhat if the shaft and the forces acting on it are represented diagrammatically, as shown in Fig. 2. The inclined lines shown as 6 and 24 inches in length represent the toe and the lever arms, respectively, and of course must be imagined as being normal to axis O–O of the shaft.

W' and W'' are both equal to W and act in opposite directions to each other; also forces F' and F'' are both equal to F and act in opposite directions to each other. These two sets of additional forces do not disturb the conditions of equilibrium of the original forces W and F acting at the ends of their respective arms. For this reason it can be assumed that the shaft is subjected to direct bending stresses due to forces W' and F' acting at axis O–O, and to secondary shearing stresses produced by the torsional moments of couples WW'' and FF''. R and R_1 are, of course, the reactions of W' and F', and their magnitudes are found from the following equations:

$$R + R_1 = W' + F'$$
$$R \times 45 - W' \times 22.5 = F' \times 7$$
$$W' \times 6 = F' \times 24$$

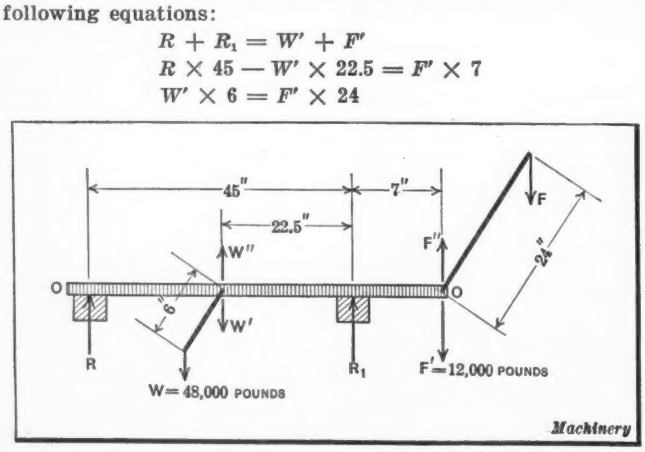


Fig. 2. Diagram indicating Direction and Magnitude of Forces acting on Crankshaft shown in Fig. 1

That is,

$$W' = \frac{12,000 \times 24}{6} = 48,000 = W$$

$$R = \frac{12,000 \times 7 + 48,000 \times 22.5}{45} = 22,133 \text{ pounds}$$

$$R_1 = 48,000 + 12,000 - 22,133 = 37,867 \text{ pounds}$$

Now the tensile or compressive unit stress due to bending alone is

$$S = \frac{22,133 \times 22.5 \times 10.2}{8^3} = 9900 \text{ pounds}$$

and the plain unit stress in shear due to the twisting moment is

$$S_s = \frac{48,000 \times 6 \times 5.1}{8^3} = 2880$$

Then, substituting these values of S and S_s in Formulas (1), we have:

$P_1 = 1/2\ (9900 + \sqrt{9900^2 + 4 \times 2880^2}) = 10,680$ pounds per square inch in tension or compression, and

$P_2 = 5730$ pounds per square inch in shear.

Shaft Design for Uniform Strength

Suppose now that we are to design a shaft of uniform strength, as shown in Fig. 3, in which the stresses should

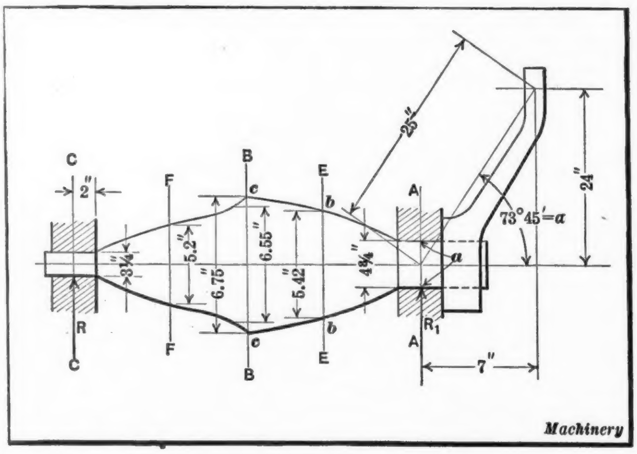


Fig. 3. Shaft designed for Uniform Strength

not exceed 18,000 pounds in tension and compression, and 12,000 pounds in shear. From the following formulas:

$$P_1 = \frac{M\ (1 + \cos a)}{2Z} \text{ and } P_2 = \frac{M}{2Z}$$

we would have for the diameter of the shaft at section A–A,

$$d = \sqrt[3]{\frac{12,000 \times 25\ (1 + 0.28) \times 5.1}{18,000}} = 4\ 3/4 \text{ inches}$$

or

$$d_1 = \sqrt[3]{\frac{12,000 \times 25 \times 5.1}{12,000}} = 5.03 \text{ inches}$$

The diameter at section B–B can be found more easily by making use of the formulas for the equivalent twisting moments for tension and shear; namely,

$$T_e = M + \sqrt{M^2 + T^2} = 18,000 \times \frac{d^3}{5.1} \text{ and}$$

$$T_{es} = \sqrt{M^2 + T^2} = 12,000 \times \frac{d_1^3}{5.1}$$

And, since $M = 22,133 \times 22.5 = 498,000$ inch-pounds, and

$T = 48{,}000 \times 6 = 288{,}000$ inch-pounds, we have, solving for d and d_1:

$$d^3 = \frac{5.1\,(M + \sqrt{M^2 + T^2})}{18{,}000} =$$

$$\frac{5.1\,(498{,}000 + \sqrt{498{,}000^2 + 288{,}000^2})}{18{,}000} =$$

301.8 and $d = 6.71$, say 6 3/4 inches

$$d_1^3 = \frac{5.1\sqrt{M^2 + T^2}}{12{,}000} = \frac{5.1\sqrt{498{,}000^2 + 288{,}000^2}}{12{,}000} =$$

242.2 and $d_1 = 6.23$ inches

At section E–E, midway between A–A and B–B, we have (since $M = 22{,}133 \times 33.75 - 48{,}000 \times 11.25 = 206{,}988$ inch-pounds, and $T = 288{,}000$ inch-pounds):

$$d^3 = \frac{5.1\,(206{,}988 + \sqrt{206{,}988^2 + 288{,}000^2})}{18{,}000} = 159$$

$d = 5.42$

$$d_1^3 = \frac{5.1\sqrt{206{,}988^2 + 288{,}000^2}}{12{,}000} = 151 \text{ inches and}$$

$d_1 = 5.32$ inches

As the cubic equations for determining these diameters (d and d_1) give very flat parabolas, these can be easily drawn free-hand through the points a, b, and c.

It is obvious that the portion of the shaft on the left of section B–B is free from torsion. Here the shaft is subjected to bending and to a maximum shear only at support C–C. Then the diameter at the edge of the frame may be conjectured from an inspection of the solutions of these equations:

$$\frac{22{,}133}{0.7854\,d^2} = 12{,}000 \qquad d = \sqrt{\frac{22{,}133}{0.7854 \times 12{,}000}} =$$

$$1.55 \text{ inch and } \frac{22{,}133 \times 2}{d^3 \div 10.2} = 18{,}000$$

$$d = \sqrt[3]{\frac{22{,}133 \times 2 \times 10.2}{18{,}000}} = 2.92, \text{ say } 2\ 15/16 \text{ inches.}$$

Also, since the section in question is subjected simultaneously to tension and shear stresses normal to each other, the figure $2\frac{15}{16}$ inches should be increased somewhat, say to 3 1/4 inches, and the value of P_1 should be calculated by Rankine's formula to determine how nearly it approaches the allowable stress of 18,000 pounds. That is,

$$P_1 = 1/2\left(\frac{22{,}133 \times 2 \times 10.2}{(3.25)^3} + \sqrt{\frac{(22{,}133 \times 2 \times 10.2)^2}{(3.25)^6} + \frac{4 \times (22{,}133)^2}{0.7854^2 \times (3.25)^4}}\right) = 17{,}400 \text{ pounds.}$$

Hence the diameter at section C–C may be made 3 1/4 inches.

Again, the diameter of the section immediately at the right of B–B, under the influence of the bending moment alone, is

$$d = \sqrt[3]{\frac{22{,}133 \times 22.5 \times 10.2}{18{,}000}} = 6.55 \text{ inches}$$

At cross-section F–F midway between C–C and B–B, we have likewise:

$$d = \sqrt[3]{\frac{22{,}133 \times 11.25 \times 10.2}{18{,}000}} = 5.2 \text{ inches}$$

Having obtained three points, the parabola can readily be drawn in, and, of course, it must be blended into the other one at the center as shown in the diagram. The deflection of such a shaft loaded at the middle with 48,000 pounds could be fairly estimated from the formula:

$$D = \frac{Pl^3}{48EI}.$$

That is,

$$\text{Deflection} = \frac{48{,}000 \times 45^3 \times 64}{48 \times 30{,}000{,}000 \times 3.14 \times 6.75} = 0.029 \text{ inch}$$

or, say, 1/32 inch, if the shaft were of uniform diameter throughout and probably not over 1/16 inch in the present case. The saving of material, which this design would effect over the first one would be approximately 180 pounds per piece.

[In the author's former article in MACHINERY, (see December, 1917, page 307) on compound stresses, the formula

$$P_1 = \tfrac{1}{2}\,(S + \sqrt{S^2 + 4S_s^2})$$

has been credited to Rankine. This formula, however, was first derived by St. Venant, and should, therefore, be credited to him.]

* * *

DRILLING DEEP HOLES OF SMALL DIAMETER

BY WILLIAM S. ROWELL

The drilling of holes less than 1/8 inch in diameter and more than 40 diameters deep represents difficulties varying with the material in which the hole is drilled, the appliances used, and the quantity and kind of lubricant, etc. This fact is well illustrated by an experience of the writer when drilling 3/32 inch diameter holes about 4 inches deep in high-speed steel, using a 14-inch Hendey lathe. The difficulties experienced by the writer in getting oil to, and chips away from, the point of the drill after it had entered the metal to a depth of 8 or 10 diameters, are difficulties commonly experienced. Having no special appliance, the usual method of frequently removing the drill and loading it with oil was followed. It occurred to the writer, however, that the forward motion of the work and the spiral flutes of the drill constituted a pumping action which removed oil from the drill hole before it had a chance to reach the bottom. As the lathe was provided with a crossed belt, a trial was made of reversing the work just as the drill was removed from the hole and allowing it to run backward until the drill, loaded with oil, was again inserted and fed rapidly, *nearly* to the bottom of the hole. At this point the belt was again shifted, driving the spindle in the opposite direction, and the drill was then fed to the work until another withdrawal was due. This cycle of operations was repeated until the hole was finished. The method proved entirely satisfactory.

A trial of the "pumping" effect of the spiral flutes in a revolving hole was afterward made with a piece of 1-inch thick iron which was held in a lathe chuck and drilled through with a 1/4-inch drill. The lathe was first run forward a few seconds and then backward a few seconds, and oil was dropped on the drill at the front side of the work while the drill protruded through the piece. The result showed that while the lathe ran forward no oil appeared on the opposite side of the piece, but as soon as the lathe and work were reversed, the oil from the drill ran freely through to the rear side. This idea might be used to considerable advantage on a small drilling machine, which can be more easily reversed than a 14-inch tool lathe.

* * *

The Ordnance Department of the U. S. Army is now engaged on an extensive program covering the redesigning of all types of artillery material, the new designs being intended to meet the requirements which were laid down some months ago by a special board of experts appointed to make a study of artillery material for use in the army. The magnitude of this work is such that the Government has been forced to call upon designers and manufacturers to take contracts for designs to be submitted. Among the designs first asked for are 75-millimeter and 105-millimeter guns and carriages, and manufacturers will also be asked to bid on the manufacture of these guns from the designs submitted. Further information may be obtained by addressing the Artillery Division of the Office of the Chief of Ordnance, U. S. Army, Washington, D. C.

UNFAIR COMPETITION IN TRADEMARKS

By CHESLA C. SHERLOCK

A western manufacturer recently had an experience with the trademark laws which has greatly changed his opinion of this form of governmental protection. His production had been cut down to the minimum during the war through lack of materials, and just as business promised to open up again he found that a certain competitor had adopted a plain imitation of his trademark.

"Why don't you prosecute?" suggested a younger member of the firm.

"Can't," retorted the manufacturer. "We were unfortunate in the selection of our trademark. The courts have said that our trademark was invalid because it contained words descriptive of the quality, characteristics, or ingredients of our product. Hence, we have no trademark at all—at least we are not entitled to governmental protection in it."

The younger member of the firm, however, was not satisfied. He felt that there must be some means of securing protection from this form of piracy, so he saw a legal acquaintance and laid the problem before him. The latter submitted a written opinion as follows:

First, it is sound legal doctrine that words descriptive of the characteristics, quality, or ingredients are not the subject matter of a trademark. A trademark is a form of monopoly granted to the individual by the Government, conferring the exclusive right to use the word, combination, device, or symbol in relation to the goods produced or sold. Since anyone has a right to use words descriptive of the quality, characteristics, or ingredients, it is obvious that such words cannot be the subject matter of a trademark. But, there are two exceptions to this rule, both arising more or less out of statute law.

The first is found in the Trademark Act of 1905. It is to the effect that where a descriptive word has been used *exclusively* for a period of ten years in relation to a certain article, it may be registered and used in a valid trademark, regardless of the general rule. The second is found where unfair competition arises or threatens to arise. One authority has said: "The function of a trademark is to indicate to the public the origin or source of the manufacture of the article which it is used to designate. It is not necessary, however, for the trademark to show these matters on its face, but it is sufficient in this regard, if, by its association with such articles in trade, the mark has acquired with the public a secondary meaning denoting the origin of the article." A manufacturer is entitled to protection from the courts in his trade devices, regardless of whether they have been registered or not, if he is faced with unfair competition. Any effort to appropriate, imitate, or steal the trade devices of another is deemed unfair competition by the courts.

Review of Actual Cases of Trademark Infringements

In Oklahoma, the supreme court said: "All practices between business rivals which tend to engender unfair competition are odious to the law and will be restrained by the courts. No man will be permitted to make use of signs or trademarks which serve to confuse the identity of his business with that of another, so as to mislead the public and divert business from his competitor to himself."

In an English case, the court said: "They have no property in the name, but the principle upon which the cases on this subject proceed is not that there is a property in the word, but that it is a fraud on a person who has established a trade and carries it under a given name that some other person should assume the same name, or the same name with a slight alteration, in such a way as to induce persons to deal with him in the belief that they are dealing with the person who has given a reputation to the name. . . . That is, a fraud on the part of a defendant to set up a business under such a designation as is calculated to lead and does lead other people to suppose that his business is the business of another person."

The United States Supreme Court, in the case of a certain manufacturing company, said: "Undoubtedly, an unfair and fraudulent competition against the business of the plaintiff conducted with the intent, on the part of the defendant to avail itself of the reputation of the plaintiff to palm off its goods as the plaintiff's, would, in a proper case, constitute ground for relief."

In another case, discussing what was necessary to constitute "a proper case," the Supreme Court said: "Much must depend, in every case, upon the appearance and special characteristics of the entire device; but it is safe to declare as a general rule, that exact similitude is not required to constitute an infringement, or to entitle the complaining party to protection. If the form, marks, contents, words, or the special arrangements of the same, or the general appearance of the alleged infringer's device, is such as would be likely to mislead one in the ordinary course of purchasing the goods, and induce him to suppose that he was purchasing the genuine article, then the similitude is such as entitles the injured party to equitable protection, if he takes seasonable measures to assert his rights and to prevent their continued invasion."

Imitations Tending to Deceive Buyer as to Identity of Manufactured Article

In another case, the Supreme Court has said: "There can be no question of the soundness of the plaintiff's proposition that, irrespective of the technical question of trademark, the defendants have no right to dress their goods up in such manner as to deceive an intending purchaser, and induce him to believe that he is buying those of the plaintiff's. Rival manufacturers may lawfully compete for the patronage of the public in the quality and price of their goods, in the beauty and tastefulness of their enclosing packages, in the extent of their advertising, and in the employment of agents; but they have no right, by imitative devices, to beguile the public into buying their wares under the impression that they are buying those of their rivals."

In a case decided by the Federal circuit court, the use of the word "cellonite" was enjoined because of its similarity to the word "celluloid." Said the court: "The defendant's name was of his own choosing and, if an unlawful imitation of the complainant's, is subject to the same rules of law as if it were the name of an unincorporated firm or company. It is not identical with the complainant's name. That would be too gross an invasion of the complainant's right. Similarity, not identity, is the usual recourse when one party seeks to benefit himself by the good name of another. What similarity is sufficient to effect the object has to be determined in each case by its own circumstances."

Use of the same descriptive word in the trade name or in connection with goods does not, in itself, amount to unfair competition. If the rival manufacturer goes a step farther and plainly labels all of his own goods with his own name, even in spite of his alleged similarity of device, it does not amount to unfair competition. In one case, it was shown that even the packages in which the goods were shipped were identical with that of the first manufacturer. The court refused to enjoin this, saying that by applying his own name to the product, in spite of the adoption of other similar characteristics, the alleged unfair competitor had absolved himself from the usual rules of law applicable to such cases.

Briefly stated, manufacturers are entitled to protection, in regard to trade names, in the following instances:

1. When they have a valid trademark, which has been properly registered in the manner prescribed by law.
2. When they have acquired a trade name, or the protection extended to an invalid trade name, as provided by statute.
3. When they have a device, not the proper subject of registration as a trademark, but one in which the courts will protect them from unfair competition, as indicated in the above instances.

Westinghouse Employment Department

Methods Used by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., in Hiring Men and in Retaining an Efficient Working Force

By JOHN C. BOWER, Superintendent of Employment Department, Westinghouse Electric & Mfg. Co

In the September and October numbers of MACHINERY, the methods of job analysis used at the Westinghouse Electric & Mfg. Co.'s plant were described, the object of the job analysis being to insure that the right man is obtained for each job in the shop. The present article will deal more specifically with the methods used in the employment department, and the records that are kept. It shows how job analysis is applied to the hiring of men.

LITTLE need be said about the general requirements of an employment department, as this subject has been dealt with both in MACHINERY and in other publications at various times. The present article, therefore, will consist mainly of a review of the actual methods that are used by the Westinghouse Electric & Mfg. Co., in hiring and retaining efficient workers.

It has been found that men recommended by foremen or by other employes are desirable. In the case where a foreman recommends a man, he will feel a certain responsibility toward the new employe, and will assist in training him for his work. He will also try to retain the man, if he feels that he is responsible for his having been hired. Recommendations from other employes that are known to have the right qualities are also desirable, because it is likely that men of the right type would recommend only men whom they are certain would meet the requirements. A form printed on thin white paper and made up into pads is therefore used, on which men can be recommended for employment. It is of advantage to have a standard form so that the recommendation can be filed away for future reference, in case the applicant is employed. Pads with these blanks are distributed to the foremen, and whoever makes the recommendation will hand it to the applicant so that he, in turn, may present it when he applies for work at the employment department. Should the applicant not be hired, the reason is given on the recommendation blank, as indicated in Fig. 1, and the form is returned to the man who made the recommendation. If this is not done, it is likely to create resentment, and future recommendations would be discouraged; but when a just reason is given, there is no ground for complaint.

If in any instance a considerable number of recommendations are received from any one man, it is generally advisable to investigate his motives. Care should be taken that no cliques are formed in the plant, and that neither too many relatives nor too many men of the same nationality—if the men are of foreign birth—are employed in the same department. Most applicants, of course, apply for work without recommendations.

How the Needs for Men in the Shop are Determined

The employment department must, of course, have correct information as to the men needed in the plant at any one time. This information is obtained by having the foremen fill out a blank entitled "Advice of Workman Required." One blank is filled out for each job (not necessarily for each man needed). This form, as shown in Fig. 2, states the number of employes required for the job; gives the name of the occupation as determined by the standard occupation list, which was described in the September number of MACHINERY; gives the job analysis card number, also referred to in the former article; and such other information as is required by the employment department in order to make the proper selection.

It will be seen how much the problem of hiring the right man is simplified by having job analysis cards. All the foreman needs to specify is the card number, and the employment department knows exactly what kind of man is needed. In a large shop, like the Westinghouse plant, employing some 20,000 men, this method is, practically speaking, indispensable.

Physical Examination

Before the applicant is definitely hired, he is given an examination in order to determine his physical fitness to fill the position for which he is to be hired. The physician making the examination should have a general knowledge of the work to be performed by the applicant, so that he would not permit the employment of anyone whose health would be endangered by his employment, or who would expose his associates to a contagious disease, or to danger through accidents caused by his own physical defects.

Application Blanks

The application blank used by the Westinghouse company (see Figs. 3 and 4) is a 4- by 6-inch index card on which

WESTINGHOUSE ELECTRIC & MFG. COMPANY
Recommendation to the Employment Department

I DESIRE TO RECOMMEND FOR EMPLOYMENT:—
NAME ______
ADDRESS ______
OCCUPATION ______
SIGNED ______ DATE ______ SEC. ______ CHECK ______

IT IS UNDERSTOOD THAT THE PARTY RECOMMENDED WILL APPLY IN PERSON OR BY LETTER I. E., HE WILL NOT BE SENT FOR BY THE COMPANY. THE EMPLOYMENT DEPARTMENT WILL PLACE THE APPLICANT TO THE BEST ADVANTAGE. THIS FORM CAN BE SENT TO THE EMPLOYMENT DEPARTMENT DIRECT OR BE PRESENTED BY THE APPLICANT

TO BE FILLED IN BY THE EMPLOYMENT DEPARTMENT
ENGAGE AS ______ TO REPORT TO ______ DATE ______
NOT ENGAGED (GIVE REASON AND RETURN TO PARTY WHO RECOMMENDED) REASON ______
DATE ______ ______ EMPLOYMENT DEPARTMENT
Form 5033-C

Fig. 1. Form used for recommending an Applicant for Employment

Form 141°-F

ADVICE OF WORKMAN REQUIRED

To the Employment Department

Date ______ 191__

Help as follows is required in Sec. ______ Dept.

Number Required	Name of Occupation	Approximate Rate

Occupation Number and Class	Job Analysis Card No.	Day Turn	Night Turn	Premium Work	Piece Work	Task Work	Day Work	Length of Instruction Period
	INDICATE BY PLACING X IN SQUARE							

The above must be filled in to agree with Rate Book in Section requesting help.

______ Foreman ______ Gen'l Foreman

Fig. 2. Form used by Foreman for specifying Help required

spaces are left for the following information: Date; occupation desired; full name; address; special experience; special education; names of concerns by whom last employed; positions held with those concerns; exact date of employment as to the month and year; place of birth; date of birth; nationality; education, whether common school, high school, college, night school, or correspondence school course; whether married, single, or widowed; number of children under sixteen years of age; number of dependents; height; weight; and citizenship. In case of foreign-born applicants, the question as to whether they have their first papers is also included, together with the date of first papers, and the number of years in the United States; and if they are citizens, the date of second papers; and in addition, the following questions: Have you ever worked for the Westinghouse Electric & Mfg. Co.? In what department did you last work? Have you ever worked for any other Westinghouse company? Have you ever served an apprenticeship, and for what trade? How long, and where? Do you keep house, board or live with your parents? Do you own your own home? Do you carry insurance—health, accident, or life? Do you speak or write English?

The questions are selected with the idea in mind of not asking anything which the average applicant would object to answering. An applicant's religion and the organizations to which he belongs are among the items that he may not want to disclose, as they are considered personal affairs and do not affect the employer or the applicant's status as an employe. The other information obtained by means of the application blank, however, is useful in selecting the man and in determining, later, proper policies in dealing with the working force.

FORM 8023-C

APPLICATION FOR POSITION

AS DATE

STATE OCCUPATION DESIRED

Full Name

Address No.	Street	City	State

Have you ever worked for this Company	Last Dept. Worked in	Have you ever worked for any other Westinghouse Company?

Have you ever served Apprenticeship and for what trade?	How long and where?

Special Experience

Special Education

PREVIOUS EMPLOYMENT AND REFERENCE

GIVE NAME OF CONCERNS BY WHOM LAST EMPLOYED	POSITION HELD	GIVE EXACT DATE OF EMPLOYMENT AS TO MONTH AND YEAR

Fig. 3. Front of Application Blank

What is done after a New Man has been Employed

If the applicant is engaged, advice to this effect (Fig. 5) is sent with him to the foreman requiring his service. This blank gives the following information: The date; the name of the foreman; the name of the applicant; the job for which he has been selected; and his hourly rate, as well as the number of the job analysis card according to which he was selected. The applicant is also provided with a check and a button of identification, which is his pass to the plant. The record of his physical examination is also specified on this form. Should the physical examination indicate that the man is not fit to fill the job for which he has been first selected by the employment department, an effort is made to find some other suitable position, and if there is none available, his application is filed in a folder for future reference. An opportunity is also given the new employe to become a member of the Relief Department, which is usually accepted.

At the Westinghouse plant, it is considered of importance to have the foreman approve of the man tentatively hired by the employment department, because no foreman should be asked to have an employe in his department unless he is satisfied with him. This also applies to the applicant, who ought to be given an opportunity to know his foreman, as few employes would stay long on a job if they were not satisfied with the executives. In some cases, the foreman may want an interview with the applicant before he is considered by the employment department, in which case this request is granted. This arrangement, however, is seldom necessary.

When the applicant has been definitely accepted by the foreman, the latter keeps the form advising him that the man has been engaged until the applicant reports for work at the specified time. Should he fail to report, this is noted on the form by the foreman, and the form is returned to the employment department and will act as a new requisition for a man for the job, making it unnecessary to fill out another "Advice of Workman Required" (Fig. 2). If the applicant does report, however, a card as shown in Fig. 6 is sent to the accounting department, together with the advice of hiring (Fig. 5) that was previously sent by the employment department to the foreman. Form Fig. 5 is returned by the accounting department to the employment department, and Form Fig. 6 is retained as a record of the employe in the accounting department. The return of the form to the employment department is a notification that the applicant has definitely reported for work, and that the requisition for a new man is filled. The form is filed in a folder provided for each employe.

When hired, a booklet is given to the new employe of the various shop rules which must be followed in the Westinghouse plant, and other items of information which are of value to him. All other information that the new man may require is also freely given to him by the employment department, and any questions that he may ask are answered.

Place of Birth	Country or State	Date of Birth			
Nationality	White	Colored	Male	Female	
Education	Common School	High School	College	Night School	Correspondence
Housekeeper?	Board?	Live with Parents?	Own your Home?		
Married?	Single?	Widowed?	Number of Children under 16 years?		
Height	Weight	Number of Dependents			
Do you carry Insurance?	Health	Accident	Life	None	
Speak or Write English?	Speak	Write	Both	Neither	
Citizen?	First Papers?	Date of First Papers			
Date of Second Papers	Years in U. S. A.				
Have you any Physical defects?	If so, What?				
Remarks:					

Fig. 4. Back of Application Blank

Employment Department Cooperates in Setting Wage Rates

At the Westinghouse plant, all occupations are classified and standard rates of pay are determined in the manner explained in the previous articles. The employment department assists in this work and is in a position to note errors that may have been made. Attention is called to such errors, and suggestions are made for improvements required in the system to meet changing conditions. Sometimes the wage payment plans may make it difficult for the employment department to obtain the right kind of men. The suggestions offered by the employment department are taken up and discussed with the executives with a view to improving the system. It has been definitely determined by the company's experience that it is better to pay a high day rate with a comparatively low premium rate, than to pay a low day rate and a high premium rate. If the day rate offered to a new applicant is low, he will compare it with the prevailing rate in other plants, and may not be willing to take the chance of making up his day's pay on premium rates.

Taking Care of Complaints of Employes

An effective method has been installed in connection with the employment department for receiving and handling

complaints made by employes. While the chronic complainer is not encouraged, it is recognized that all complaints should be investigated and that the employment department must be in a position where it can receive these complaints and properly look into their cause. This is done during the noon hour. The general superintendent is also present at the noon hour at the employment department for interviews with employes in the plant. Frequently grievances which would have grown into difficult problems have been received and adjusted at this time.

Transferring Men from Department to Department

It is often necessary to transfer a man from one department to another, either because the employe requests a transfer to more suitable or desirable work, or because the employe is no longer needed in one department, but may be advantageously employed in another. A special form, Fig. 7, is provided for this purpose also, which is filled in by the foreman to notify the employment department when a man desires a transfer or when his services are no longer required in the department where he works. On the back of the blank the foreman writes down his opinions as to whether the request should be considered or not, and gives his reasons. When the application for transfer has been received by the employment department, an investigation is made and the applicant for transfer is interviewed. In granting transfers, care should be taken never to show any partiality, and to grant transfers only when there is a good reason. Under the system of classification of jobs used by the Westinghouse Electric & Mfg. Co., men must sometimes be transferred to better jobs in order to obtain a higher rate of pay, the transfer being in the form of a promotion. When properly done, transfers to more suitable work prevent much discontent.

Form 1386—C

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

ADVICE OF WORKMAN SUPPLIED

Date________

Mr.________ GENERAL FOREMAN

Section________

Mr.________ FOREMAN

________ has been engaged as

________ Occupation No.________

Occupation Class________ Job Analysis Card No.________

RATE PER HOUR:	Premium	Piece Work	Task Work	Day Work	
NIGHT TURN DAY TURN					Day rate effective at once: other rate effective when employee starts on contract work, which should not be later than________

Physical Examination Class ________

Check No.________ Section________ ________ EMPLOYMENT DEPARTMENT

If workman fails to report for work, return this slip to Employment Department; otherwise it is to accompany Card 5400 to the Pay Roll Division if for check employee, or card 4400 to the Salary Record Division if for a salaried or hourly pass employee.

EMPLOYMENT DEPARTMENT—W. E. & M. CO.

Please issue pass to bearer________

who is to begin work in Section________

on Day Turn / Night Turn Date________

________ FOREMAN

Fig. 5. Notice sent to Foreman when Employe is hired

Reducing the Working Force

When it becomes necessary to lay off men in any one department, the employment department is notified on the same blank (Fig. 7) in advance of the contemplated lay-off, so that there is an opportunity to place the employe in some other department. This reduces the labor turnover and creates a feeling of appreciation on the part of the employe toward the plant. It is of importance to keep a man who has received special training in the plant, because later it may become necessary to reinstate him in his former position, when his services are required there. This method often obviates training new men. Discharges are also avoided as far as possible, even when a man does not prove satisfactory in a certain department. The foreman realizes that although a man may not prove satisfactory to him, he may fit into another department on a different line of work, and the transfer system aids in reducing the number of discharges.

Efficiency Records of Employes

The employment department maintains a record of every employe, which gives the employe's name; the rate of his advancement in the organization; the number of times he has been employed, if he has returned after having once left; the departments he has worked in; and the length of his service, whether intermittent or continuous. Other information of value is also included, and the record is referred to in case an ex-employe returns for employment. This record is also used by the employment department in considering transfers and in dealing with complaints. At the Westinghouse plant, this record is made in the form of a folder so that it can be used for filing within it the application card and other forms relating to the employe.

A record of service is also kept on a card, 4 by 6 inches. This record, Fig. 8, gives the most essential information about the employe, and contains an analysis of his characteristics. This form is provided at the time the applicant is employed, and filled in from time to time with the required information. When the employes know that a record is being kept of their efficiency and that this record is the determining factor in selecting them for promotion or increasing their pay, its effect is marked. It is also possible to promote systematically and with fairness. In case an employe complains because he is not promoted, the record furnishes generally an answer to his complaint. If the employe leaves the company and returns for re-employment, this record is also valuable in determining whether or not he ought to be re-employed.

How to Reduce the Labor Turnover

In order to reduce the labor turnover, the employment department should obtain the real causes for men either leaving their employment voluntarily or being dismissed. These causes should be classified into four main heads, as follows: Other positions; dissatisfied; discharged; and unavoidable. These main causes may be further subdivided as follows:

Other Positions—Better position; former position; going into business for himself; higher pay elsewhere; work nearer home; leaving to learn a trade.

Dissatisfied—Earnings too low; general human environment in plant; living conditions; nature of work; objection to foreman; unsafe or unsanitary

RATE CARD—Hourly Rated Employee

Working Hours		
Per Day	Sat.	Sunday

Employment ☐ Rerate ☐ Change in Occupation ☐ Transfer ☐

Full Name	Section ____	Prem.	Pc. Wk.	Rate or Rerate Task	Day Wk.	Night Turn Only
	Check No.____					☐
________	Date ____					

Occupation________ No. ____ Class____

(To be filled out for rerate only)

Previous Rate____ Has been effective since____ Occupation________ No ____ Class____

(To be filled out in case of change in occupation)

Previous occupation________ No.____ Class____

(To be filled out in case of transfer)

Transferred from Section____ Check No.____ Rate____ Occupation________

Occupation No.____ Class____ Tool Account OK____ Time Department____

Foreman ____ Gen'l Foreman____ Employment Dept.

(To be filled out by department in which employee is located or will be located)

Foreman	Gen'l Foreman	Supt.	Rate Dept.	Rate Comm.	Time Dept.

Form 5400-G

Fig. 6. Card sent to Accounting Department as a Permanent Record

conditions; night work; working with colored men; wanting to make a change. Absence for two weeks without giving any reason is also placed in this class.

Discharged — Carelessness; dishonesty; disobedience to shop rules; incompetency; intemperance; irregular attendance.

Unavoidable—Lack of work; death; returning to school; home conditions; pensioned on account of age; sickness.

The labor turnover may be materially decreased if the real reasons for leaving the work in the plant are determined, so that conditions within the plant may be corrected to prevent good men leaving in the future. The employment department interviews every man who gives notice that he expects to leave, and encourages him to remain. The interview, to be effective, must be obtained while the employe is still at work and should be arranged as soon as possible after notice has been given that the man expects to leave. In order to provide for sufficient time to encourage the employe to remain, a notice of three days is required of the men who expect to leave, before they will be able to get their pay. The same blank (Fig. 7) that is used for reporting transfers is also used for giving notice of leaving the employ of the company. This notice is given to the foreman, who, in turn, fills out the blank and sends it to the employment department. When the reasons for quitting indicate that unsatisfactory conditions exist in the department where the man is working, an investigation is made by the employment manager and the facts, if necessary, are reported to the executive who has authority to remedy the conditions.

Form 5931-A

REPORT ON EMPLOYEE—

Date__________191___

Name__________ Sec.__________ Chk. No.__________

Address No.______ Street______ City______ State______

Occupation__________ Occupation No.__________ Class No.__________

Hourly Rate   Average Earned Rate Last Three Months.   Dept. Rating

THE ABOVE NAMED EMPLOYEE Check a, b, c, d, e, as case may be and fill in date

a ☐ Desires a Transfer

b ☐ Desires to leave the Employ of the Company with Notice on__________ Date 19___

c ☐ Desires to leave the Employ of the Company without notice__________ Date 19___

d ☐ Has not reported for work since__________ Date 19___ and has not been reported to Relief Dept. as being sick or injured.

e ☐ Service not (Required) (Desired) after__________ Date 19___

Member of Relief Dept.?______ Relief Dept. No.______ Relief Dues______

__________ Foreman   __________ Employee

__________ Gen'l Foreman   __________ Pay Roll Division

__________ Ch. Cost Clerk   __________ Relief Dept.

(GIVE REASONS ON BACK OF CARBON COPY)

TO BE FILLED IN **ONLY** BY THE EMPLOYMENT DEPARTMENT

☐ Quit With Notice ☐ Quit Without Notice ☐ Laid off Reduction of Force ☐ Transferred ☐ Discharged

Date__________19___   __________ Employment Department

Fig. 7. Form used for reporting on Transfers, Leaving Company's Employ, etc.

Method of Discharging Employes

In discharging employes, a notice is sent by the foreman of the plant to the employment department, as mentioned. The employe is entitled to a hearing by the employment manager before being definitely discharged. This method has proved to be satisfactory to all concerned, as it places upon the employment department the responsibility of the discharge and does not prevent this department from placing the employe somewhere else in the plant, should this seem advisable. The foremen like the arrangement because it removes from them the responsibility of discharge, but allows them, at the same time, the privilege of deciding who should remain in their departments. If a foreman is unfair in dealing with an employe, this will generally be disclosed by the investigation made by the employment manager. The employment manager is assisted in this work by an adjustment committee appointed by the management.

When men are dismissed during slack periods, a record of their addresses is kept so that they may be communicated with as soon as a need for men again arises. This makes it possible to rehire many old employes who have been given the proper training for the work for which they are required.

Reports to the Management

A brief monthly report giving the most important items relating to the employment department is sent each month to the executive management of the plant. At the end of each year a general report is made of the work, which also contains suggestions concerning possible improvements in the plant and its systems, with a view to making it easier to hire and hold a desirable class of men.

Kinds of Forms to Use in the Employment Department

A detail that may seem of small importance, but which has been found to require attention, is that of selecting the proper kinds of forms and using the proper kinds of paper for the forms, in order that the records kept may be as useful as possible. When forms are to be filled in with ink, the paper should be such that it will take writing well. All forms to be made out in duplicate should be put up in pad form. White paper is the best for all blanks, as it provides records that are most easily read. When there are a number of questions on the form, the space should be so blocked off that the answers to one question will not be confused with the answers to another. As far as possible, questions should be so asked that a simple check mark is all that is necessary for an answer. If this is not possible, a simple "yes" or "no" is all that should be required. Whenever the same form can be adapted for use for two purposes, it is well to do so, in order to reduce the number of forms. Most forms can be made of the standard 4- by 6-inch index card size.

SERVICE RECORD—WORKS EMPLOYEE Form 6008-C

Name in Full	Address (in Pencil)

Country of Birth	Date of Birth	U. S. Citizen	Dependents	Date Last Employed

Date	Occupation	Number	Class	Section	Check Number	Contract Rate	Day Rate

Grade

Date of Rating	Performance	Accuracy	Carefulness	Knowledge	Skill	Speed	Total	Characteristics	Adaptability	Dependability	Industry	Character	Tact	Total	Intelligence	Analytical	Common Sense	Perception	Resourceful	Teachable	Total	Physical Qualities	Activity	Endurance	Health	Physique	Strength	Total	Leadership	Self Expression	Initiative	Judgment	Self Confidence	Self Control	Total	Grand Total

Fig. 8. Employe's Service Record Card

Production Milling on Automatic Machines

Advanced Practice in the Milling of Duplicate Parts—Third Installment

By EDWARD K. HAMMOND

IN the June number of MACHINERY a description was published of the "Ohio" tilted rotary milling machine which had just been placed on the market at that time by the Oesterlein Machine Co., of Cincinnati, Ohio. Provision has been made in the design of this miller to enable it to be operated on either the continuous rotary or the indexing principle. Continuous rotary milling has already been fully discussed in this series of articles on milling practice, so that further reference to the subject is unnecessary. When used as an indexing machine, two or more work-holding fixtures are mounted at the periphery of the circular table of the "Ohio" miller, and a suitably arranged mechanism provides for alternately indexing the table to bring the next piece of work into the operating position, and then feeding the cutter-head in toward the center of the table, so that the cutters are fed across the work. Such an arrangement enables a high rate of production to be attained, because a number of pieces of work may be mounted around the periphery of the table, and the table may be indexed at high speed to bring the successive castings or forgings into the milling position. The cutter-head is also withdrawn from the work at high speed, the slow-feed movement being utilized only during the actual cutting. The operator of this machine is only required to remove the finished pieces of work from the fixtures and set up fresh blanks, so that there is virtually no idle time of either the machine or its operator.

Milling Yoke Forgings on "Ohio" Indexing Milling Machine

Fig. 1 shows a machine equipped with two work-holding fixtures arranged for operation on the indexing principle. This machine is used at the plant of the Stuebing Truck Co., Cincinnati, Ohio, for straddle-milling the outside faces of cast-steel yokes. The advantage secured by the indexing principle of operation is quite apparent in this case, because if the machine were used as a continuous rotary miller, a great deal of time would be lost in moving the table through practically a complete semicircle between each of the milling cuts. As the cuts are quite short, the percentage of idle time would be very high, especially in view of the fact that a low rate of feed must be used in milling these steel castings. The illustration shows the machine just as it is about to commence the straddle-milling operation. The spindle head carrying the straddle-mills will feed radially toward the center of the table, until the cut is completed, after which a dog will automatically trip the feed movement and engage a rapid return mechanism which will carry the cutters quickly out of engagement with the work. At the same time, the table indexing mechanism will be automatically engaged, causing the table to be quickly moved through a half revolution, ready for milling the next casting which has been set up in the fixture at the opposite side of the table. While this piece is being milled, the operator will remove the finished piece and substitute a fresh blank in its place.

On this job, it is of great importance to provide work-holding fixtures with a quick-acting clamping mechanism, because the time required to take the cut on these forgings is quite short, so that the operator has only a limited period in which to remove the milled yoke, and to set up a rough forging in its place. For this purpose, it is merely necessary for the operator to turn nut A through about half a revolution, after which the bolt may be swung on pivot B to enable strap C to be raised. On the under side, it will be seen that this strap carries a V-block D that fits over the top of the forging; and on its under side, the forging is supported by a similar V-block E. Endwise location of the work is provided by a pilot F, which fits through a hole that has previously been drilled in the inner end of each forging. After the milled piece has been removed from the fixture, the operator sets up a new forging by merely slipping it over pilot F and then dropping strap C into place on top of the forging. The clamping bolt is next swung up into the slotted end of strap C, after which nut A is tightened. Very little time is required for unloading and reloading the fixture. On this operation, the time taken in milling one forging is forty seconds; that is to say, the rate of production is ninety forgings per hour.

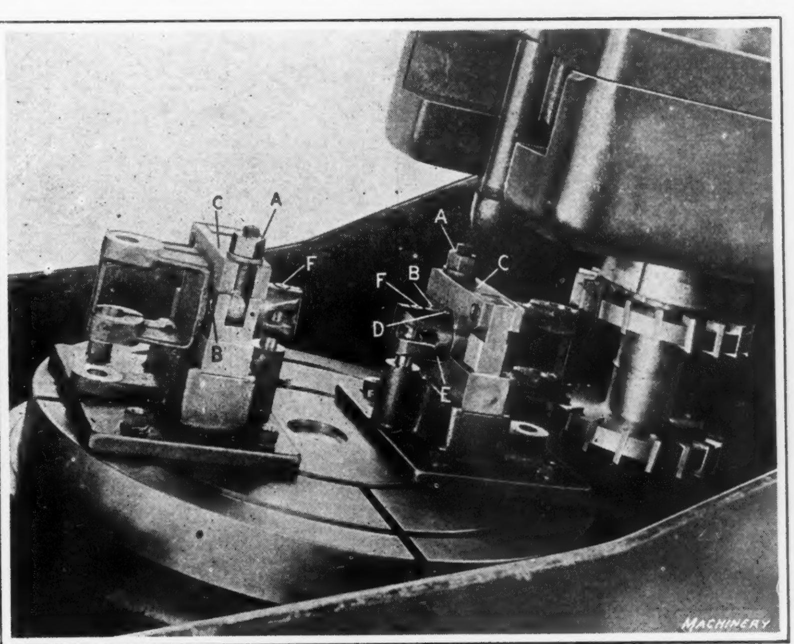


Fig. 1. Straddle-milling Yoke Forgings on "Ohio" Tilted Rotary Milling Machine operated on Indexing Principle

Operations on Potter & Johnston Indexing Milling Machines

Before entering upon a discussion of the methods of handling those milling operations that can be advantageously done on the indexing type of machine built by the Potter & Johnston Machine Co., Pawtucket, R. I., it will be

well to present a brief description of features of this miller. From Fig. 2 it will be seen that two parallel work-holding tables are provided, which are mounted at a fixed height from the floor on a circular indexing turntable that provides for bringing the two work-holding tables alternately into the operating and loading positions. This arrangement enables the shop using a milling machine of this type to secure the usual benefits of the so-called "continuous-production" machines; namely, that the operator loads the work in the fixtures mounted on one table, while the cutters are working on pieces held in fixtures on the other table, so that both the machine and the operator are kept constantly employed, except for the brief intervals during which the machine is indexing. The finished work is not moved back under the milling cutters, and as a result, there is no danger of marring the finish of the work in making such a return movement of the table. By mounting the spindle on a slide carried by the column, provision is made for obtaining vertical adjustment of the position of the spindle; and the column is carried by a horizontal slide which affords transverse adjustment for the spindle, so that any desired position on the table can easily be reached.

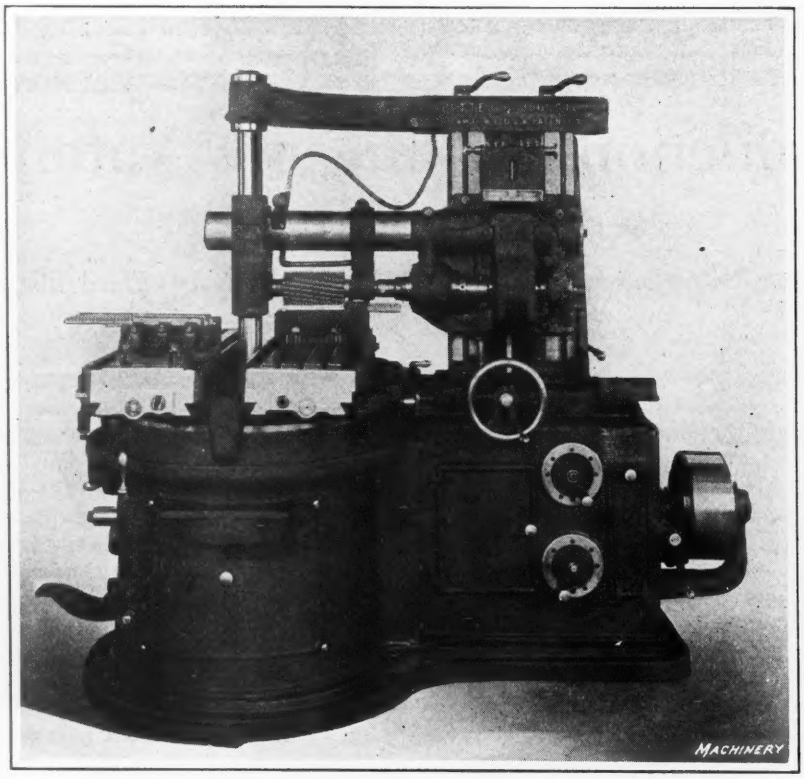


Fig. 2. Automatic Indexing Type of Milling Machine built by the Potter & Johnston Machine Co.

Milling a Turret Revolving Pawl

Fig. 3 shows two views of the finished turret revolving pawl after being milled, and also diagrams indicating the manner in which successive milling operations are performed in making this part. According to the method of procedure used at the plant of the Potter & Johnston Machine Co., there are nine operations required for the production of each of these pawls. The first eight are milling operations, and these will be discussed in detail; but as the final operation consists of drilling and counterboring a hole in the pawl, no consideration will be given to this part of the work. The machine steel from which these pawls are made is delivered to the milling department in blocks measuring 10 3/16 inches long by 2 inches high by 1½ inches thick. Each of these pieces of steel contains sufficient material for making two pawls, a piece 5 inches in length being required for each pawl, while 3/16 inch is allowed for the kerf removed by a parting tool. The reader will obtain the best idea of the way in which the successive operations are performed on these parts by referring to Fig. 3, which shows in diagrammatic form the successive steps that are involved. Operation 1 consists of squaring up the four sides of each steel blank, so that they are at accurate right angles to each other. After this has been done, the second operation is to part the blanks at the center, in order to produce two pieces, each of which is 5 inches in length.

Some of the methods employed in tooling up the Potter & Johnston indexing rotary milling machines for the performance of operations on these pawls are quite unusual, and as they are the means of effecting substantial reductions in production costs on those operations where they are em-

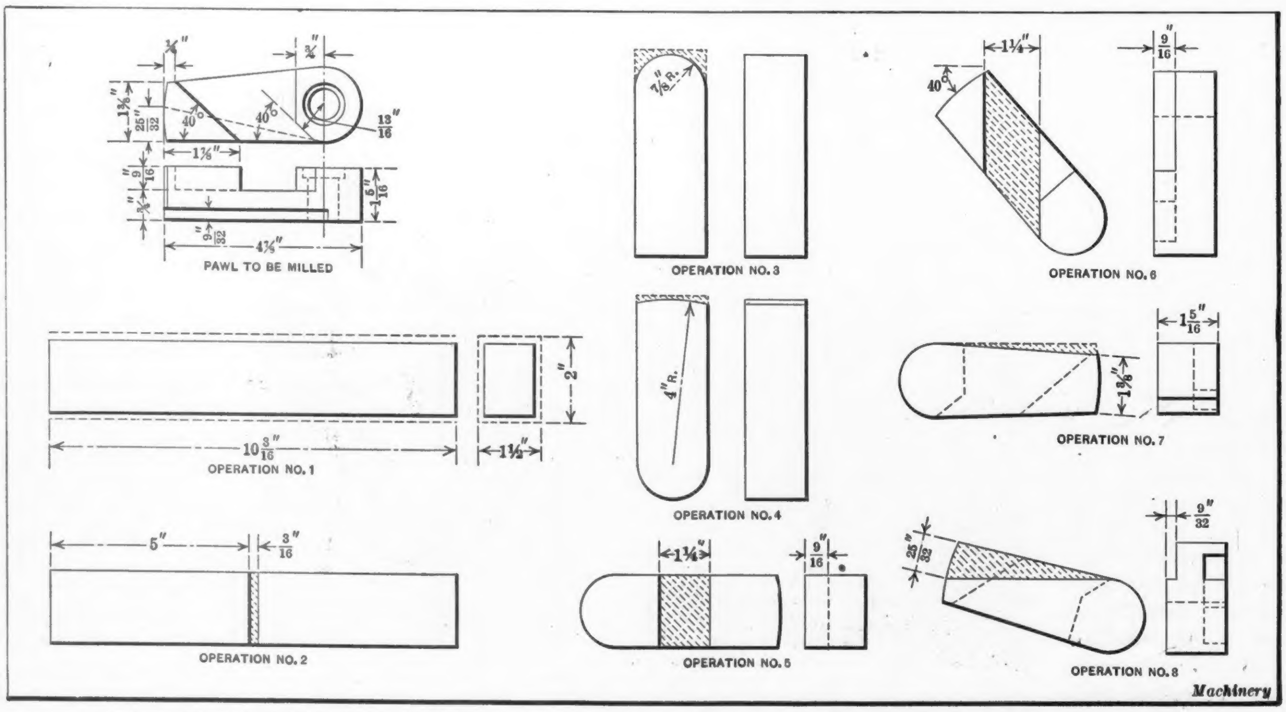


Fig. 3. Turret Revolving Pawl to be milled, and Diagrams showing Successive Milling Operations to be performed on this Part

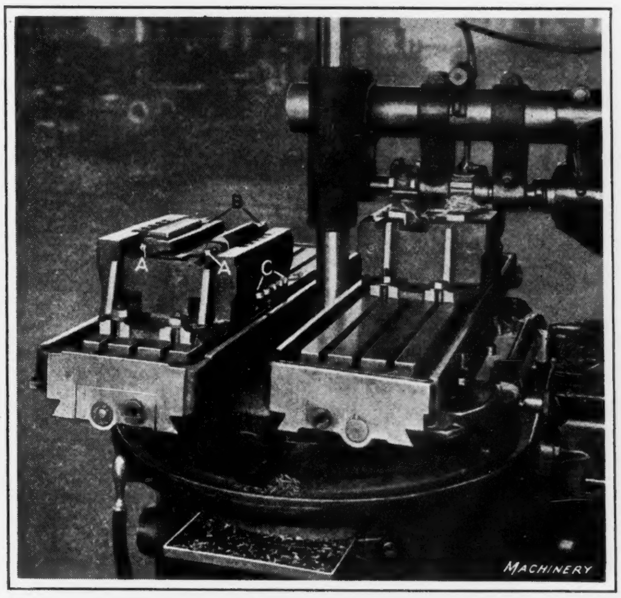


Fig. 4. Indexing Milling Machine equipped for performing Third and Fourth Operations on Turret Revolving Pawls

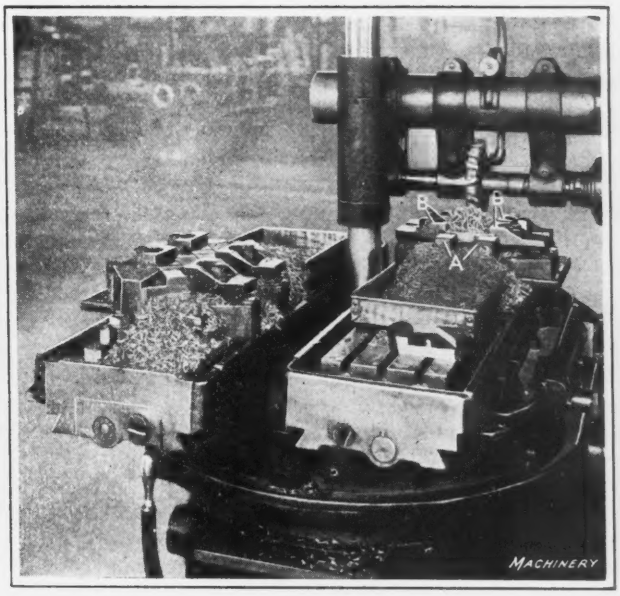


Fig. 5. Indexing Milling Machine equipped for performing Fifth and Sixth Operations on Turret Revolving Pawls

ployed, special emphasis will be laid upon such features in order that the readers of MACHINERY may fully appreciate their importance, and consider the possibility of applying similar methods in handling milling operations in their own shops. A case in point is seen in the provision made for performing Operations 3 and 4, as indicated in the diagrams shown in Fig. 3. The machine used for the performance of both of these operations is illustrated in Fig. 4, where it will be noticed that provision is made on a single machine for simultaneously performing two operations. Two concave or formed milling cutters finish the upper and lower edges of the blanks to a radius of 7/8 inch and 4 inches, respectively.

It will be apparent that the fixture mounted on each of the work-holding tables of this Potter & Johnston milling machine provides for holding two rows of five pieces each, so that at every traverse of the table ten pieces are milled, five on the upper end and five on the lower end. Then the turntable is indexed to bring the fixture carrying these milled pieces around to the loading position. Very little thought will make it apparent that five of these pieces have been milled at both the top and bottom, while the other five have only been milled at the top. As a result, five finished pieces are removed from the fixture, and the other five, which have only been milled at the top, are taken out of that side of the fixture in which they were held for the third operation, turned over end for end, and replaced in the opposite side of the fixture, on the same table, ready for performing the fourth operation. Then five other pieces are set up in the other side of the fixture ready to have the third operation performed on them. After milling operations have been performed on the pieces carried by the fixture mounted on the other work-holding table, the machine will be indexed to provide for milling the pieces that have just been set up. The fixtures for holding the work for milling are of quite simple design. It will be recalled that the blanks have already been faced off on all four sides, and in setting them up for the third and fourth operations, five blanks are secured in each side of the work-holding fixture. By tightening set-screws *A*, these pieces of work are pushed back against blocks *B*, which support the thrust of the milling cutters. Then as an additional means of steadying the work and holding it down in the fixture, five set-screws *C* are provided at each side, and tightened against the work.

As in the case of Operations 3 and 4, a single Potter & Johnston indexing type of milling machine is employed for the performance of Operations 5 and 6. The fifth operation consists of milling a transverse slot 1 1/4 inches wide by 9/16 inch deep across one side of the work; and after this has been done, a diagonal slot of the same depth and 1 1/4 inches in width is milled at an angle of 40 degrees to the sides of the blank. The result produced by the combination of these two milling operations is to form one side of the pawl, as

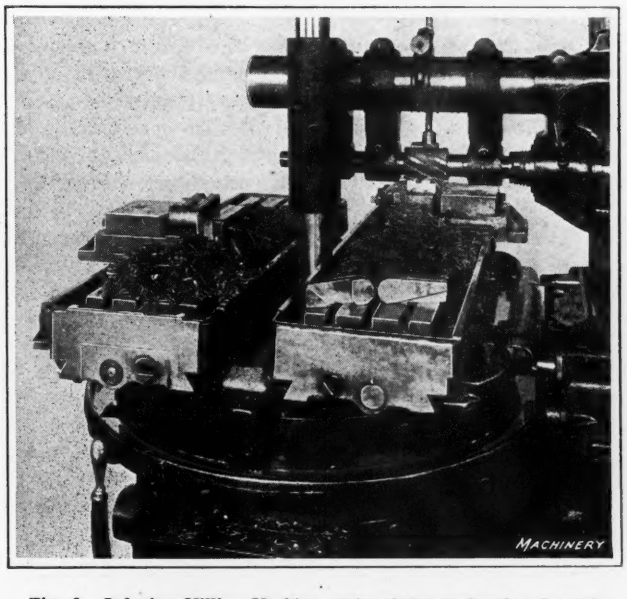


Fig. 6. Indexing Milling Machine equipped for performing Seventh Operation on Turret Revolving Pawls

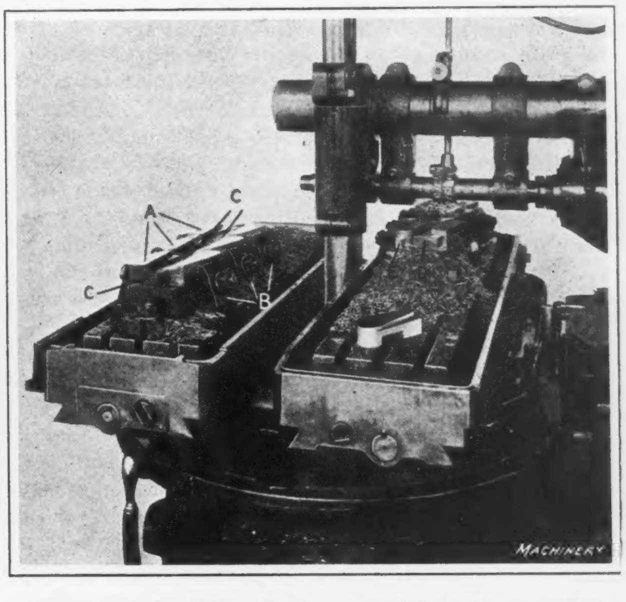


Fig. 7. Indexing Milling Machine equipped for performing Eighth Operation on Turret Revolving Pawls

shown at the upper left-hand corner of Fig. 3. A milling machine equipped for performing Operations 5 and 6 is illustrated in Fig. 5, but the provision made in this case for handling two successive operations on a single machine is somewhat different from that which was shown in the preceding illustration. In the present instance, only one milling cutter is required on the arbor, and the performance of the fifth and sixth milling operations with this cutter is accomplished by setting the work at different angles for handling the two operations. On the work-holding table shown at the right-hand side of the machine in Fig. 5, it will be seen that the fixture provides for holding the pieces at right angles to the direction of travel of this table, so that a straight slot is milled across the work, as indicated diagrammatically for the fifth operation in Fig. 3. At the left-hand side of the machine, a similar form of work-holding fixture is provided, except that this fixture holds the pieces inclined at an angle of 40 degrees to the direction of travel of the table. The pieces milled while held in the fixture mounted on the right-hand table are taken out when this table is indexed to the loading position, and they are then set in the

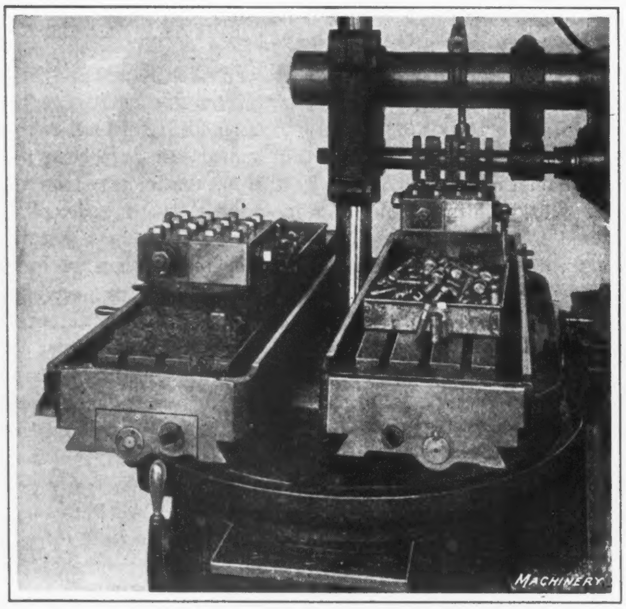


Fig. 8. Indexing Rotary Milling Machine equipped for squaring Heads of Cap-screws

fixture on the other work-holding table, ready for the performance of the sixth operation, as indicated in Fig. 3.

It will be apparent from Fig. 5 that the work-holding fixtures provided at both sides of the machine are of simple design. They have thrust blocks *A*, which serve the double purpose of supporting the work against the pressure of the milling cutter, and also locating the pieces to be milled at the proper angle to the direction in which the table travels. Obviously, the thrust block will be at right angles to the direction of table travel for the fifth operation, and inclined at an angle of 40 degrees for the sixth operation. After the pieces of work have been located against these thrust blocks, they are held down by means of straps *B*, which are made of sufficient width so that each strap holds two pieces of work. Four pieces are held in each fixture, so that the milling operation can be performed on all of them at a single setting of the work.

Operation 7 consists of milling one side of the turret revolving pawl to a slight taper angle, and for the performance of this operation the Potter & Johnston milling machine is equipped as shown in Fig. 6. It will be evident that the fixture carried by the work-holding table at each side of the machine consists of a milling vise of standard design, which holds two pieces of work. The only special feature of each of these vises is that a tapered block is placed between the jaws, and the work to be milled is laid on this block before the jaws are tightened. In this way, provision is made for inclining the sides of the two pieces of work at such an angle, that the regular horizontal movement of the table results in milling off one side of the work to the desired angle of taper.

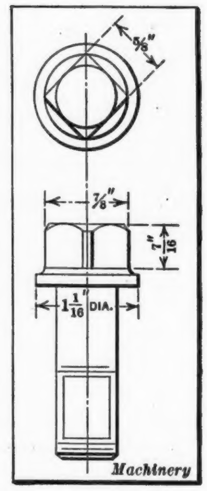


Fig. 9. Cap-screw

The eighth and final milling operation performed on these pieces, consists of milling the opposite edge of the pawl in the manner indicated in Fig. 3. Here it will be seen that the cut to be taken is 9/32 inch deep, and that it is taken at an angle to the parallel edge of the work, thus sharpening the wedge-shaped form of the highest portion of this side of the pawl. Fig. 7 shows the equipment of a Potter & Johnston milling machine for the performance of this operation. It will be seen that the work-holding fixture mounted on each of the tables is so designed that provision has been made for mounting six pieces of work in each fixture. The fixtures on both tables are of identical design, and it will be apparent that each has two rows of work *A* mounted in it. Two rows of straps *B* hold these pieces; and the proper location of the work is obtained by means of center blocks *C* against which the work is clamped, to obtain the proper inclination with the direction of travel of the work-holding table.

It will be seen that two inserted-tooth milling cutters are mounted on the arbor, and these are located in such a way that a single traverse of the table provides for milling the two rows of pieces of work on their inner edges. In order to perform the operation in this way, it will be evident that the work must be set up in the fixture with the ends of the pieces in one row facing in the opposite direction to the ends of the pieces in the other row held by the same fixture. On each fixture there are a block *D* and a pin *E*, which support the pieces of work at the ends of the two rows, so that the thrust of the milling cutters will not have a tendency to cause these pieces to alter their position in the fixture.

For the performance of these eight successive milling operations, individual production times have not been tabulated, but the rate at which fully milled turret revolving pawls are produced is three per hour. The material is machine steel, and in accordance with the usual practice, the cutters and work are supplied with a copious flow of a cutting emulsion made of soluble oil and water. This is an important point in milling steel, because the tendency of the work to become heated will make it impossible to operate under maximum conditions of production, unless such a precaution is taken.

Straddle-milling Bolt Heads on Potter & Johnston Machine

It is for such work as the milling of duplicate parts which are made in large quantities, that the Potter & Johnston automatic indexing milling machine is able to show the greatest saving in production costs. An example of such work is shown in Fig. 8, which illustrates one of these machines set up for straddle-milling bolt heads. It will be apparent from this illustration that each work-holding table is provided with a fixture that carries sixteen bolts in four rows of four bolts each. On the arbor of the milling machine there is mounted a gang of eight cutters with spaces left for traversing the four rows of bolts between them, to mill the flats on opposite sides of the heads. After this has been

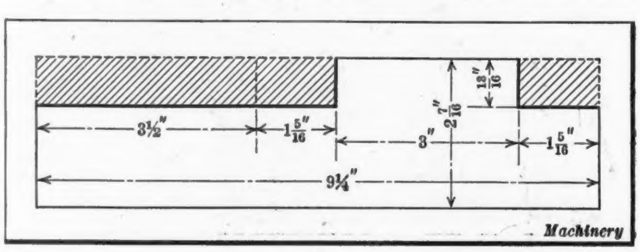


Fig. 10. Turret Revolving Pawl Block on which Milling Operations are performed by Machines shown in Figs. 11 and 12

done, the turntable is indexed to bring the opposite work-holding table and fixture into the milling position. The bolts which have already been fed between the cutters have been milled on two sides of their heads, and to provide for milling the other two sides, each work-holding fixture is mounted on a pivot and provided with an index mechanism, so that it may be swung through an angle of exactly 90 degrees.

When the operation has been completed on the work mounted in a fixture on one side of the turntable, the machine is indexed to bring the opposite fixture into the milling position. By feeding the bolt blanks between the cutters a second time, the remaining two sides of the heads are milled, thus finishing the operation. The possibility of indexing the entire fixture in order to provide for milling the second pair of sides on the bolt heads, instead of having to remove all of the pieces from the fixture and reset them in the required position for the second operation, is naturally the means of effecting a substantial saving in the amount of time required for milling these parts. With the equipment illustrated in Fig. 8, the rate of production attained is 160 milled bolts per hour.

Milling Turret Revolving Pawl Blocks

Fig. 10 shows a piece known as a turret revolving pawl block, which is produced in large quantities at the plant of the Potter & Johnston Machine Co., Pawtucket, R. I. This job is one which may be advantageously handled on an indexing type of milling machine of this company's manufacture. Figs. 11 and 12 show machines equipped for the performance of two successive milling operations on this piece. For the first cut taken on the machine shown in Fig. 11, it will be evident that the work-holding table at each side of the turntable is equipped with a fixture that provides for holding four of the steel blanks from which these turret revolving pawl blocks are made. This first cut consists of removing a section of metal from one end of the blank, which is 3½ inches long by 13/16 inch in depth.

It will be seen that on the machines shown in both Figs. 11 and 12, the work-holding fixtures are of essentially the same design, and that each fixture provides for holding four of the blanks for turret revolving pawl blocks. The fixtures are of simple design, consisting of two walls *A* at right angles to each other, against which the four blanks are located to bring them at exactly right angles to the direction of travel of the table. One of these two walls of the fixture also serves to support the four blanks against the thrust exerted by the milling cutters. It will be seen that at each of the other two sides of the fixture, there are two straps *B* which are tightened to locate the work firmly against the two opposite walls, to which reference has just been made. These straps are placed at an angle, so that they serve the additional purpose of forcing the work firmly down on the bed of the fixture.

Referring to Fig. 11, it will be seen that the arbor of the milling machine carries three inserted-tooth cutters, which are of sufficient width to provide for taking the preliminary cut that is 3½ inches in length by 13/16 inch deep. The position of this cut is indicated by dotted lines in Fig. 10. For the second operation on these parts, the work is set up in the machine shown in Fig. 12, where it will be seen that two pairs of inserted-tooth milling cutters are mounted on the arbor to provide for taking a cut 1 5/16 inches in width by 13/16 inch deep at each end of the high portion that still remains on the blank, thus bringing it to the condition shown in Fig. 10. In setting up these two machines, it will be noticed use is made of two gangs of two milling cutters, in Fig. 12; and of a gang of three cutters, in Fig. 11. The reason for using these gangs of cutters with interlocking teeth, instead of employing a single cutter in each case, is that the spiral angles of the teeth of cutters comprising such a gang can be opposed to each other, thus neutralizing much of the end thrust on the work; and in addition, such a method of setting up cutters on an arbor allows the action of the milling machine to be smoother than would otherwise be the case. It will be seen that this principle of using a gang of cutters in place of one, has been quite generally employed in setting up the Potter & Johnston machines for the performance of those milling operations which have been discussed. For the operations performed on the machines shown in Figs. 11 and 12, the rate of production is fourteen completely milled turret revolving pawl blocks per hour.

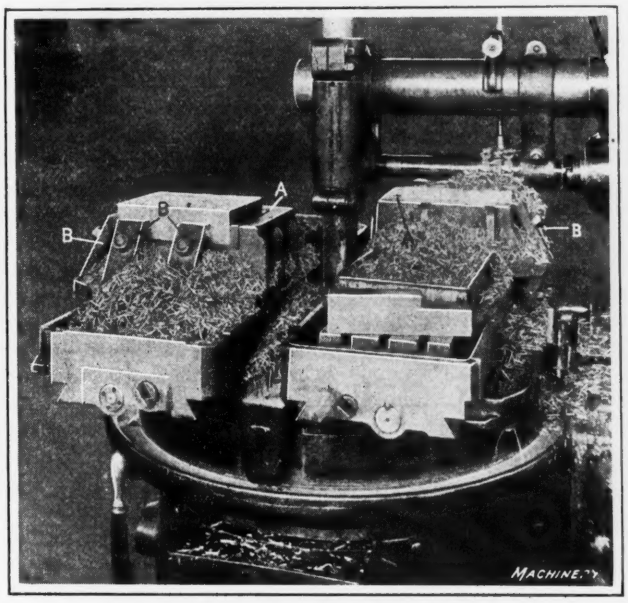


Fig. 11. Indexing Rotary Milling Machine on which the First Operation is performed on the Turret Revolving Pawl Block

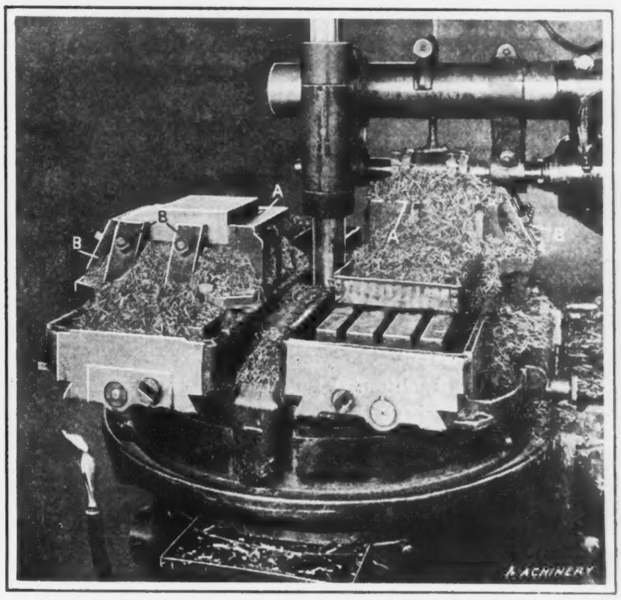


Fig. 12. Indexing Rotary Milling Machine on which the Second Operation is performed on the Turret Revolving Pawl Block

* * *

The United States Railroad Administration, in a circular recently issued, calls attention to the cooperation that manufacturers can give the railroads in order to prevent car shortage during the coming winter. In this circular, it is mentioned that shippers and receivers of freight can assist the railroads, and their own industries as well, by loading all cars to the full possible or carrying capacity, by prompt loading and release of cars, by ordering cars only when actually required, by eliminating the use of railway equipment in transfer service that can be handled equally well by motor truck, by reducing the diversion and reconsignment of cars to a minimum, by promptly unloading cars, by ordering goods in quantities representing the full carrying capacity of cars, by ordering from the nearest available source, and by pooling orders so as to secure full car loads.

Designing Change-Gears

Calculations Involved in Designing Change-gear Mechanisms for Machine Tools so that Speeds will Vary in Geometrical Progression

By W. C. STEUART

PRACTICALLY all machinists and shop men, and the great majority of draftsmen and designers as well, know little of the calculations involved in designing a series of change-gears for a machine tool. Perhaps there has been a reluctance on the part of those who understood the subject to impart their knowledge to others. The writer has seen designers who had this work in hand, and yet who knew so little of the simple mathematical principles that govern the matter that they would figure for days in a haphazard cut-and-try fashion. The result was often a series of irregularly progressing speeds or feeds, frequently overlapping in one or more places. These overlaps or duplications of speeds were regarded as unavoidable.

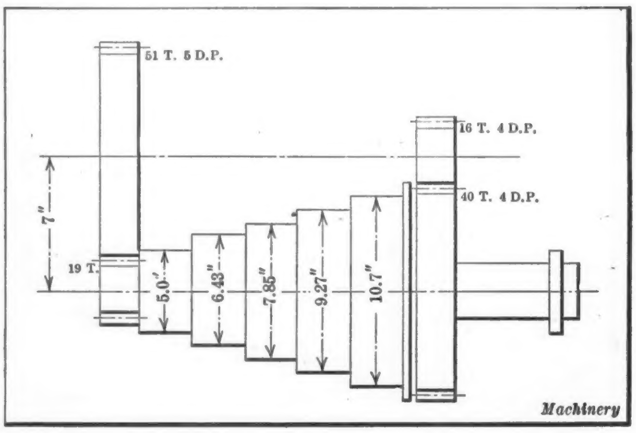


Fig. 1. Designer's Sketch of Cone Pulley and Back-gearing of Lathe Headstock

In most calculations with which the designer has to do, the slide-rule is a great time-saver, but those who do not understand it need not despair, for with a table of geometrical progression ratios at hand, nothing more obtruse than an occasional recourse to square root will be required of them. It is not the intention to deal with any given set of change-gears to be applied to a particular kind or size of machine tool, but merely to explain the methods that may be followed in practically all cases. Indeed a comparison of machines of the same size and for the same purpose as offered by different builders discloses an astonishing variation in the number and range of speeds and feeds afforded by the various designs. A perusal of the catalogues of any of the well-known lathe builders will confirm this. The designer must be guided in each instance by his knowledge of what others are doing along the same line, the latest practice in the most progressive shops, and the recent developments in tool steels. Occasionally, the requirements of some particular customer will have considerable weight in deciding the matter; especially in the case of machines originally designed as special machines and afterward put on the market. The best plan of all in the case of a standard line of machines is to find out what the other fellow is offering and try to improve upon his machine. This does not mean to steal all or a part of his design, but merely to find out how far we have to go to outdo him. Of course it is impossible to work up a line of standard machine tools without adopting features that appear in other machines, for if new machine tools were so made, they would probably be regarded as freaks, and would be unsalable.

Speed Calculations for Lathe Headstock

We will begin with one of the simplest and most familiar of varying speed propositions—the lathe headstock with the stepped cone pulley and simple back-gears, as in Fig. 1. The headstock is to have a five-step cone with back-gears, giving ten speeds in all, and the speeds are to range from 300 down to 10 revolutions per minute.

The first thing to determine is the geometrical progression of ten numbers from 1 to 300. Perhaps it may be well to explain the difference between geometrical and arithmetical progression, as this is a thing one generally forgets immediately after learning it, like algebra, unless one has use for it. Numbers in arithmetical progression progress by adding a constant number: as 2-4-6-8-10-12, etc., while numbers in geometrical progression progress by multiplying a constant ratio: as 2-4-8-16-32-64, etc., the numbers given having a ratio of 1 to 2. It is in this latter manner that the speeds and feeds of machine tools usually progress.

Now returning to the lathe headstock, we proceed to find the speeds either by logarithms, by the use of tables, or by the slide-rule method which was explained in a recent number of MACHINERY. (See "Calculating Geometrical Progression," June, 1919, page 973). We find that to have speeds from 10 to 300 revolutions per minute, ten in number, we must use a ratio of 1.46, which on multiplying gives the results shown in the first column of Table 1. Five of these speeds are obtained from the five-step cone. The function of the back-gear is to double the speeds, making ten in all. We have decided, from observation or experience, that the least practicable diameter for the smallest cone step is 5 inches. This gives a starting point from which all the other cone steps may be calculated, as their ratios must be to one another as the ratios of their speeds.

TABLE 1

Speeds Varying in Geometrical Progression	Speeds Actually Obtained
10....... = 10.0	9.7
10 × 1.46 = 14.6	14.5
14.6 × 1.46 = 21.3	21.0
21.3 × 1.46 = 31.0	30.0
31 × 1.46 = 45.3	45.0
45.3 × 1.46 = 66.0	65.0
66 × 1.46 = 96.4	97.0
96.4 × 1.46 = 140.5	140.0
140.5 × 1.46 = 205.0	202.0
205 × 1.46 = 299.3	300.0

Machinery

The highest speed is obtained, of course, when the belt is driving from the largest step of the countershaft cone to the smallest step of the headstock cone and the back-gear is out of mesh. It is customary to make the countershaft and headstock cones alike; consequently the two middle steps will be of the same diameter, which makes the countershaft speed the same as the middle speed of the cone, without the back-gears, or 140.5 revolutions per minute. The size of the largest step may be obtained by the following formula:

$$\text{Diam. largest step} = \frac{\text{Max. spindle speed} \times \text{Diam. smallest step}}{\text{Speed of countershaft}}$$

Applying this formula we have:

$$\text{Diameter of largest step} = \frac{300 \times 5}{140.5} = 10.7 \text{ inches}$$

The middle step should next be determined. It is the sum of the large and the small diameters divided by 2:

$$5 + 10.7 \div 2 = 7.85 \text{ inches}$$

The second largest step will be the mean between the middle and the largest step:

$$7.85 + 10.7 \div 2 = 9.27 \text{ inches}$$

The second smallest step in like manner will be:

$$5 + 7.85 \div 2 = 6.43 \text{ inches}$$

The back-gears obviously must be of such ratio as to reduce the first five speeds to a second or slower five. The ratio between the slowest of the first five and the slowest of the second five is as 10 to 66 revolutions per minute or 6.6 to 1. As the back-gear consists of two pairs of gears, this ratio is the product of their respective ratios, and we must extract the square root to find what these respective ratios may be. The square root of 6.6 is 2.56. Therefore the ratio of each pair of gears should be 2.56 to 1. We may now proceed to find the number of teeth in the gears. It is customary to make the gears next to the faceplate of heavier pitch, as they are the slowest running and consequently transmit the most power, or to speak more correctly, they have the greatest tooth pressure. Suppose we find by calculation, experience, or comparison with other makers (the last two methods are the best) that the faceplate gears should be 4 diametral pitch and the back-gear shaft admits of using a 15-tooth pinion. Then:

$15 \times 2.56 = 39$ teeth, approximately
$15 \div 4 = 3\frac{3}{4}$ inches pitch diameter
$39 \div 4 = 9\frac{3}{4}$ inches pitch diameter

One-half of the sum of the pitch diameters, or $6\frac{3}{4}$ inches, equals the center-to-center distance. So far the process is simple, but here we strike one of those snags with which every designer is familiar; we wish to make the other pair of gears 5 diametral pitch, but 5 diametral pitch gears will not fit into $6\frac{3}{4}$-inch centers. The solution of the problem is to make the faceplate gears with 16 and 40 teeth, respectively, which will make the centers an even 7 inches, as shown in Fig. 1.

$16 \div 4 = 4$ inches pitch diameter
$40 \div 4 = 10$ inches pitch diameter

TABLE 2

Counter-shaft Speed, R.P.M.	Counter-cone Diam., Inches	Headstock Cone Diameter, Inches	Back-gears	Spindle Speeds, R.P.M.
140 ×	10.7 ÷	5.00	Out	= 300
140 ×	9.27 ÷	6.43	Out	= 202
140 ×	7.85 ÷	7.85	Out	= 140
140 ×	6.43 ÷	9.27	Out	= 97
140 ×	5.00 ÷	10.7	Out	= 65
140 ×	10.7 ÷	5.00 ×	(19 × 16 ÷ 51 × 40)	= 45
140 ×	9.27 ÷	6.43 ×	(19 × 16 ÷ 51 × 40)	= 30
140 ×	7.85 ÷	7.85 ×	(19 × 16 ÷ 51 × 40)	= 21
140 ×	6.43 ÷	9.27 ×	(19 × 16 ÷ 51 × 40)	= 14.5
140 ×	5.00 ÷	10.7 ×	(19 × 16 ÷ 51 × 40)	= 9.7

Machinery

$$\text{Therefore the center distance equals } \frac{10 + 4}{2} = 7 \text{ inches.}$$

This alters the ratio slightly, as the ratio of 40 to 16 is 2.5. The difference must be made up in the other pair of gears as follows:

$6.6 \div 2.5 = 2.64$ ratio for 5 diametral pitch gears.

Twice the center distance or 14 inches is the combined pitch diameters of the gears, and with 5 diametral pitch the combined number of teeth is 70. The desired ratio is 2.64. Add 1 to this ratio and divide it into the total number of teeth. Thus:

$70 \div 3.64 = 19$, approximately

Therefore we have 19 teeth in the pinion and 70 — 19 = 51 teeth in the gear. The spindle speeds will now be checked as shown in Table 2 to see how close we have come to the desired result. We will make the countershaft speed 140 revolutions per minute even. The results shown in Table 2 are also compared with the ideal speeds in Table 1. It is possible to get even closer results by a little juggling, but such accurate speeds are seldom necessary.

Calculations for Feed Mechanisms

As we have now gained a knowledge of methods, the next problem, while more complicated in some respects, will not require so much explanation. We will continue with the lathe, taking the feed this time. The design of lathe to be considered does not conform to good practice, inasmuch as the lead-screw does the feeding. Very few, if any, lathe builders make lathes of this kind in these days, as it causes too much wear on the lead-screw and renders it inaccurate for screw-chasing; but as screw feeds are often used on other machine tools, and moreover, as the application of the same

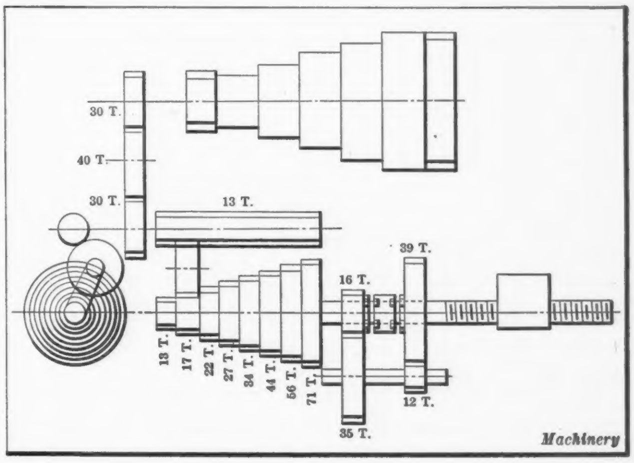


Fig. 2. Sketch of Feed-changing Mechanism of Lathe

gearing to the usual lathe feed will be considered later, we will depart from the established path for the time being. Our example this time is shown in Fig. 2, which illustrates a cone of gears and a swinging idler driven from the main spindle by suitable connecting gears. We shall assume that the lead-screw is to have 4 threads per inch, (a very common pitch for lead-screws) and the feeds are to vary from $\frac{1}{4}$ to 1/150 inch per revolution of the spindle. Spindle speeds are expressed in terms of revolutions per minute, while feeds are given in terms of feed in fractions of an inch per revolution of the spindle; consequently, if the speed is doubled, we double the feed per minute, but not per revolution of spindle. Sixteen feeds in all are required and these are to be obtained by using eight gears in the cone and a back-gear similar to that on the spindle drive.

As the screw has 4 threads per inch, it is manifest that its fastest speed is one revolution to one revolution of the spindle and its slowest speed, $1/150 \times 4 = 1/38$ revolution approximately. By using the numbers 4 and 150 the geometrical progression may be determined. By one of the methods already alluded to we find the ratio to be 1.275. The various gear ratios may then be determined by repeatedly multiplying by the ratio of the geometrical progression. These gear ratios are given in the first column of Table 3. The second ratio is given as 1 to 1.28 instead of using the exact value of 1.275. In the next column, these ratios are expressed by numbers representing the numbers of teeth in the gears. When the lead-screw makes one revolution to one revolution of the spindle, which is the case when the drive is from the long pinion having 13 teeth to the gear having 13 teeth, the feed per revolution will be $\frac{1}{4}$ inch, because there are 4 threads per inch on the lead-screw, so that one revolution of the latter is equivalent to a $\frac{1}{4}$-inch feeding movement. Consequently, the values in the last column are approximately equal to one-fourth of the gear ratios, or their equivalent values as expressed by the numbers of teeth.

The first eight feeds are obtained through the cone of eight

gears. Between the eighth and ninth feed the back-gear comes into play. The ratio of this back-gear will be the ratio between the first and ninth feeds or 1 to 6.95. We might find the square root of 6.95 and make both pairs of gears alike; but one of the pinions must have a clutch face while the other has not, and therefore it is better practice to accommodate them to this difference. Suppose we find it necessary to make the clutch pinion with 16 teeth and the

TABLE 3

Gear Ratio	Numbers of Teeth in Gears	Feed per Rev. of Spindle, Inch
1 to 1.00	13 ÷ 13	1/4
1 to 1.28	13 ÷ 17	1/5
1 to 1.62	13 ÷ 22	1/6.4
1 to 2.07	13 ÷ 27	1/8
1 to 2.62	13 ÷ 34	1/10
1 to 3.35	13 ÷ 44	1/13
1 to 4.27	13 ÷ 56	1/17
1 to 5.45	13 ÷ 71	1/22
1 to 6.95	13 ÷ 13 × (12 × 16 ÷ 39 × 35)	1/28
1 to 8.85	13 ÷ 17 × (12 × 16 ÷ 39 × 35)	1/35
1 to 11.27	13 ÷ 22 × (12 × 16 ÷ 39 × 35)	1/45
1 to 14.80	13 ÷ 27 × (12 × 16 ÷ 39 × 35)	1/57
1 to 18.30	13 ÷ 34 × (12 × 16 ÷ 39 × 35)	1/71
1 to 23.40	13 ÷ 44 × (12 × 16 ÷ 39 × 35)	1/92
1 to 29.80	13 ÷ 56 × (12 × 16 ÷ 39 × 35)	1/120
1 to 37.80	13 ÷ 71 × (12 × 16 ÷ 39 × 35)	1/156

Machinery

other pinion with 12 teeth. The sizes of the two remaining gears might be determined by algebra, but a little guessing and trial will be as rapid and will be easier for the non-mathematical. Both pairs of gears must have the same center distance. Let us try 34 and 38 teeth.

$$34 \times 38 \div 12 \times 16 = 6.73$$

This ratio is not quite large enough, so another trial will be made using 35 and 39 teeth.

$$35 \times 39 \div 12 \times 16 = 7.10$$

This ratio is a little too much, but is as close as it is practicable to come to the desired result. The reader will understand that the three gears driving from the spindle to the long pinion do not enter into the calculations, as they are gears of the same size, a 30-tooth gear driving a 30-tooth gear, with a 40-tooth idler in between, the size of which has no effect whatever on the speed. (See Fig. 2).

Now suppose we do not want to use a screw for feeding, but wish to follow the approved practice in lathe design and use a splined shaft in combination with a rack and pinion and worm-gear. The splined shaft may either take the place of the screw, or, as in a lathe, may parallel the screw and be driven from it by even gears. If we wish to obtain the same feeds as with the screw, we must have a 1 to 4 ratio in the rack and worm-gear combination to make it equivalent to the lead-screw having 4 threads per inch. To obtain exactly the same feeds, a circular pitch rack is required. A diametral pitch rack would vary somewhat from the even circular pitch desired. Assume that the rack is ½ inch circular pitch and that the pinion has 12 teeth. Then as the circumference of a 12-tooth pinion of ½-inch circular pitch is 6 inches, every turn of the pinion-shaft will give a feed of 6 inches. We must reduce this to ¼ inch as follows:

Circumference of pinion or 6 × 4 = 24 teeth in worm-gear

This is correct for a single-thread worm; if the worm has a double thread, the wheel must have 48 teeth, a triple thread, 72 teeth, and so on.

Speed-changing Mechanism of Horizontal Boring Machine

The next problem will be a horizontal boring machine. This is a somewhat more complicated proposition than the preceding, yet having mastered the simple principles of the first three problems, the reader will have no difficulty with this one. We will suppose that the spindle speeds are to range from 10 to 200 revolutions per minute, and the geometrical ratio is 1.31 for a range of twelve speeds obtained from the arrangement of gearing shown in Fig. 3. The speeds are to be as listed in Table 4. As the ratio 1.31 causes the last two speeds to fall slightly short of the speeds desired, namely, 151 and 198 instead of 152 and 200, we will arbitrarily increase them to suit our requirements. As 400 revolutions per minute is a good speed for the driving pulley, we will adopt that as its speed.

Table 4 resolves what may at first sight seem a formidable problem, into a very simple calculation. The ratios of the first three or simple gear changes are the ratios of the first three speeds. Thus:

$$200 \div 152 = 1.31 \qquad 200 \div 115 = 1.72$$

The ratio of the first or lowest back-gear will be the ratio between any speed of the first series of three and any speed of the second series of three of the same relative position.

$$200 \div 88 = 2.26 \text{ or } 115 \div 51 = 2.26$$

The ratio of the second back-gear will be the ratio between any of the first series and any corresponding speed of the third series. Thus:

$$200 \div 39 = 5.1 \text{ or } 152 \div 29.6 = 5.1$$

For the last and greatest reduction we use the two back-gears combined, which gives the three slowest speeds shown in the table.

The next step is to find just how many teeth the gears must have to give the desired ratios. There are a great many factors that govern the size of gears, such as the size of the shafts, the peripheral speed which affects both the quiet running qualities and the wear, permissible diameter of the largest gear, etc. Usually the conditions are such that the best results are obtained by making the smallest pinion as small as possible, the pinion having, say, thirteen or fourteen teeth, which is the smallest number that will give good wearing qualities. Let us suppose that the shaft diameters permit the use of fourteen teeth in the smallest pinion. Then the first pair of gears for the highest simple ratio will have 14 and 24 teeth. (See Fig. 3). Thus:

$$14 \times 1.72 = 24 \text{ teeth in the large gear}$$

The combined number of teeth in this pair will determine the total number of teeth in the other two pairs. Thus to find the second pair we must consider that $1 + 1.31 = 2.31$ and dividing this into the total number of teeth:

$$14 + 24 = 38 \qquad 38 \div 2.31 = \text{say 17 teeth in the pinion}$$

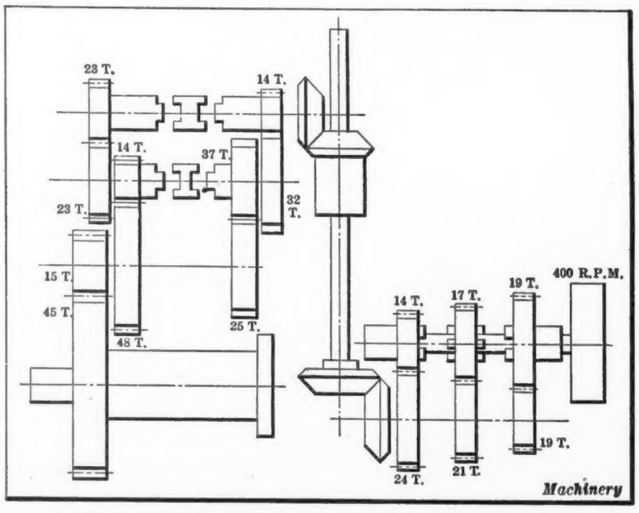


Fig. 3. Gearing for varying Speed of Horizontal Boring Machine Spindle

Now 17 teeth in the pinion subtracted from the total number of teeth equals 21 teeth in the gear. The 1 to 1 gearing will of course be:

$$38 \div 2 = 19 \text{ teeth in both gears}$$

The next consideration is the first or 1 to 2.26 back-gear. Again using 14 teeth for the pinion we have:

$$14 \times 2.26 = 32 \text{ teeth in the large gear}$$

The other or even pair of this combination will have 23 teeth each. It is well to call attention here to the fact that the back-gears in this case are single pairs of gears used alternately with a pair of even gears, instead of the double

gear reductions used in the former examples. In some cases where very large reductions are required, it is impossible to obtain the necessary ratio with one pair of gears. Even in the present instance the ratio of the second back-gear of 1 to 5.1 would call for too large a gear to work into some designs; and for purposes of illustration we will suppose that to be the case in the present instance. There is but one way to solve the problem without the use of compound gearing such as we used in the other examples; thus, instead of making the other pair of the set even, make them multiply, that is, make the driven gear run faster than the driver. Too much multiplication is inadvisable, as the friction of the gears becomes too great and consumes too much power. This can be clearly demonstrated by trying to turn a train of clock gears by hand, using the large gears as drivers. A slight multiplication is not objectionable, however. Personally the writer does not believe in multiplying more than 1.5 to 1, but considers that much permissible.

It will be apparent upon a little consideration, that by whatever amount we make the non-reducing gears multiply, by just that amount we may lower the reduction in the reducing pair. Thus if we make the multiplication 1.5 to 1 then the reduction will be as follows:

$$5.1 \div 1.5 = 3.4$$

The reducing pair will be 3.4 to 1 instead of 5.1 to 1. Again taking 14 teeth for the pinion, we will have:

$14 \times 3.4 = 48$ teeth in the large gear, as shown in Fig. 3

To find the multiplying pair, take the total number of teeth in the reducing pair, 62 teeth, and divide by $1.5 + 1$ as we did with the other change-gears:

$62 \div 2.5 = 25$ teeth and $62 - 25 = 37$ teeth

Then the driver will have 37 teeth and the driven gear 25 teeth as shown in Fig. 3, and the ratio equals 1.5 to 1. These gear calculations should now be checked as shown by Table 5. The figures representing spindle speeds have been given as whole numbers, except in one place, decimals being considered non-essential. The 17 to 21 gear combination is the only one that gives results deviating very much from the ideal speeds. The smaller the aggregate number of teeth in the combinations, the more these variations are likely to occur, but within reasonable limits, they are of no consequence in speed or feed gearing; it is only in screw-cutting or indexing combinations that we must sacrifice every other consideration to obtain the exact ratio. The 15 to 45 combination in the faceplate drive is purely arbitrary; so long as we maintain the 1 to 3 ratio, the number of teeth may be anything desired, the size of these gears being entirely a matter of design.

TABLE 4

Spindle Speeds, R.P.M.	Gear Ratios	Back-gear Ratios	Faceplate
200.0	1 to 1		1 to 3
152.0	1 to 1.31		1 to 3
115.0	1 to 1.72		1 to 3
88.0	1 to 1	1 to 2.26	1 to 3
67.0	1 to 1.31	1 to 2.26	1 to 3
51.0	1 to 1.72	1 to 2.26	1 to 3
39.0	1 to 1	1 to 5.1	1 to 3
29.6	1 to 1.31	1 to 5.1	1 to 3
22.6	1 to 1.72	1 to 5.1	1 to 3
17.2	1 to 1	1 to 5.1 × 1 to 2.26	1 to 3
13.1	1 to 1.31	1 to 5.1 × 1 to 2.26	1 to 3
10.0	1 to 1.72	1 to 5.1 × 1 to 2.26	1 to 3

Machinery

AMERICANIZATION WORK CONDUCTED BY WORCESTER MANUFACTURERS

A few weeks ago, the Norton Co., Worcester, Mass., announced the graduation of its Americanization classes. The Norton Co. is one of several Worcester manufacturers who have adopted systematized methods for Americanizing their foreign-born employes, and there is every evidence that in that city the experiment has been a success. Working directly under the guidance of the Bureau of Immigration, an Americanization committee, with Waldo Lincoln as chairman and Carl F. Dietz as secretary, has achieved some definitely practical results, particularly in the industries where the foreign-born and foreign-speaking employes became an ever-increasing majority of the labor element as more and more Americans entered the war service. It became important to place before these foreign-born workers correct ideas as to America's part in the war as well as to the principles for which America stands, whether in peace or in war. Classes were formed in the night schools as well as in industrial plants for instructing the foreign-born workers along these lines and to point the way to citizenship. The Norton Co. doubtless led the several Worcester industries in this work, Mr. Dietz, the secretary of the Americanization committee, being the general sales manager and vice-president of this company. Aided by the Worcester committee, the Norton Co. established three classes for its non-English-speaking employes, conducted wholly on the principle of giving free instruction on the company's time.

These three classes met for one-hour sessions twice a week, the classes representing, respectively, the illiterate, the intermediate, and the advanced stage, and as fast as the individual progressed, he was promoted to the next higher class. The personal work in the class-room was managed by Anthony A. Lepore, whose knowledge of languages and whose understanding of the foreign-born man's point of view were practical assets in making this work a success. For a period of more than six months, these classes pursued their study of English, practicing conversation, and reading from simple text-books about American ideals and American leaders. Twenty-seven employes have graduated so far, and have been given a diploma in Americanization, issued by the Department of University Extension under the Massachusetts state system of education.

It is of great importance to note that these twenty-seven men were all enthusiastic to become American citizens, and have all taken out their first citizenship papers. Graduation exercises were held in the assembly hall of the company with the entire personnel of the classes and their families and friends present.

The importance of work of this kind cannot be too highly estimated. There would be far less difficulty with foreign-born labor in the United States if employers generally would, either individually or on the cooperative basis, adopt methods for Americanizing foreign-born workers.

TABLE 5

Driving Pulley, R.P.M.	Change-gears	Back-gears	Faceplate Gears	Spindle, R.P.M.
400 ×	19 ÷ 19 ×	(23 ÷ 23) × (37 ÷ 25)	× (15 ÷ 45) =	198
400 ×	17 ÷ 21 ×	(23 ÷ 23) × (37 ÷ 25)	× (15 ÷ 45) =	159
400 ×	14 ÷ 24 ×	(23 ÷ 23) × (37 ÷ 25)	× (15 ÷ 45) =	115
400 ×	19 ÷ 19 ×	(14 ÷ 32) × (37 ÷ 25)	× (15 ÷ 45) =	87
400 ×	17 ÷ 21 ×	(14 ÷ 32) × (37 ÷ 25)	× (15 ÷ 45) =	69
400 ×	14 ÷ 24 ×	(14 ÷ 32) × (37 ÷ 25)	× (15 ÷ 45) =	51
400 ×	19 ÷ 19 ×	(23 ÷ 23) × (48 ÷ 14)	× (15 ÷ 45) =	39
400 ×	17 ÷ 21 ×	(23 ÷ 23) × (48 ÷ 14)	× (15 ÷ 45) =	31
400 ×	14 ÷ 24 ×	(23 ÷ 23) × (48 ÷ 14)	× (15 ÷ 45) =	23
400 ×	19 ÷ 19 ×	(14 ÷ 32) × (48 ÷ 14)	× (15 ÷ 45) =	17
400 ×	17 ÷ 21 ×	(14 ÷ 32) × (48 ÷ 14)	× (15 ÷ 45) =	13.6
400 ×	14 ÷ 24 ×	(14 ÷ 32) × (48 ÷ 14)	× (15 ÷ 45) =	10

Machinery

Representative Government in a Manufacturing Plant

A Plant Where the Principles of the American Forms of Government are Applied Because the Employers Believe that this System Fosters a Spirit of Cooperation and Mutual Interest Which Strengthens the Organization and Increases its Efficiency

An Interview with J. J. CALLAHAN, Assistant to the President, Passaic Metal Ware Co., Passaic, N. J.

THE representative system of factory government, which has been called "industrial democracy," is founded on the principle that *cooperation* between all the members of an industrial organization is always better than *competition*, and that every employe should work *with* the company rather than *for* it. No arguments are needed in support of the fact that cooperation in any organization, whatever its object, fosters a spirit of contentment among its members and develops in them a greater capacity for effective work. There are many theories and schemes designed to allay industrial strife. Some are based entirely upon the system of wage payment. Perhaps the employe is rewarded if his daily output exceeds a certain fixed task or quantity, or possibly he receives a certain percentage of the profits, as provided for by whatever plan has been adopted. Let the system of wage payment be what it may, if the employes believe that the scheme of the management is to get from them the maximum and give to them the minimum, their natural impulse is to reverse this order and give the least in labor for the highest wage obtainable.

The Representative Government Plan of Management

Both the employer and the employe may believe in dealing justly with each other, but this will not come about as long as there is a feeling of distrust between them. Since this distrustful spirit is in so many instances due entirely to misunderstanding, any plan of organization which brings the employer and the employe closer together is worth at least a fair trial. The particular plan which is to be considered, has been developed and applied to factory administration by John Leitch, who defines it as "getting on a man-to-man basis." It is presented here in the belief that the readers of MACHINERY are interested in any system of shop and factory administration which has been so highly regarded as to be applied in nearly fifty large manufacturing and industrial plants throughout the United States. While any readjustment of industrial conditions which gives the workers a direct voice in the management naturally meets with opposition from many employers, the fact remains that the effort to place the industries upon a more democratic basis is advancing steadily, and employers are becoming very enthusiastic over the improvements resulting from a representative system of administration.

Representative Management Applied to a Sheet Metal Plant

The Passaic Metal Ware Co., of Passaic, N. J., is one of the plants where industrial democracy, or the representative system of administration, is in successful operation. This system of management is modeled after the government of the United States. There is an executive body, or "Cabinet," a "Senate," and a "House of Representatives." The Cabinet is composed of the officials of the company, and its membership is not controlled in any way by the employes. The cabinet has the power to veto any "bill" that may have been passed by the other governing bodies, but it is a notable fact that the use of this power has never been necessary, either at the plant of the Passaic Metal Ware Co., or, so far as is known, in any of the other plants where this system of administration has been adopted. This shows that the workers do not try to institute radical changes that would not be mutually beneficial. The president of the company is the President of the Cabinet.

The Senate is composed of the foremen, heads of departments, or supervisors. Whenever a department foreman enters the employ of the company, he automatically becomes a member of the Senate, and the selection of foremen rests with the company officials. The Senate elects a president, and also whatever committees are needed. The employes throughout the plant elect the members of the House, and there are representatives from all departments, so that the interests of each class of workers may be properly looked after. The number of representatives depends upon the number of employes in a department, the idea being to have a representative for each group of approximately twenty people. The House elects a speaker, or chairman, and it also works through selected committees, the same as the Senate.

Sessions of Senate and House

The sessions of both the Senate and House are held during working hours. At the Passaic Metal Ware Co.'s plant the Senate meets every Friday afternoon at 1:30, and the House at 3:15. The illustration on page 257 shows the Senate in session, while the heading illustration shows a meeting of the House. In this plant there are about four hundred fifty employes. The Senate has eighteen members, and the House twenty-one members. The discussions during the meetings of these legislative bodies center largely upon improving the

means of production, which is partly due to the fact that this system of management shows clearly the relation between profits and the means of making them possible. Perhaps one department is not receiving material of the right kind or the required quantity from another department, and as everyone responsible is a member of the Senate, the difficulty is located and steps are taken to remedy it; or possibly a machine or some tools are not working satisfactorily —the Senate is then concerned with the reason why. During these discussions as to the best ways and means, facts are often brought to light and improvements are finally made which would not be possible in a plant where this interchange of ideas was not encouraged, or was entirely lacking. When manufacturing methods or other technical details are considered from every angle and from the viewpoint of every department, which is what occurs at these Senate meetings, a more efficient plant is the result; at least, that has been the experience of the Passaic Metal Ware Co.

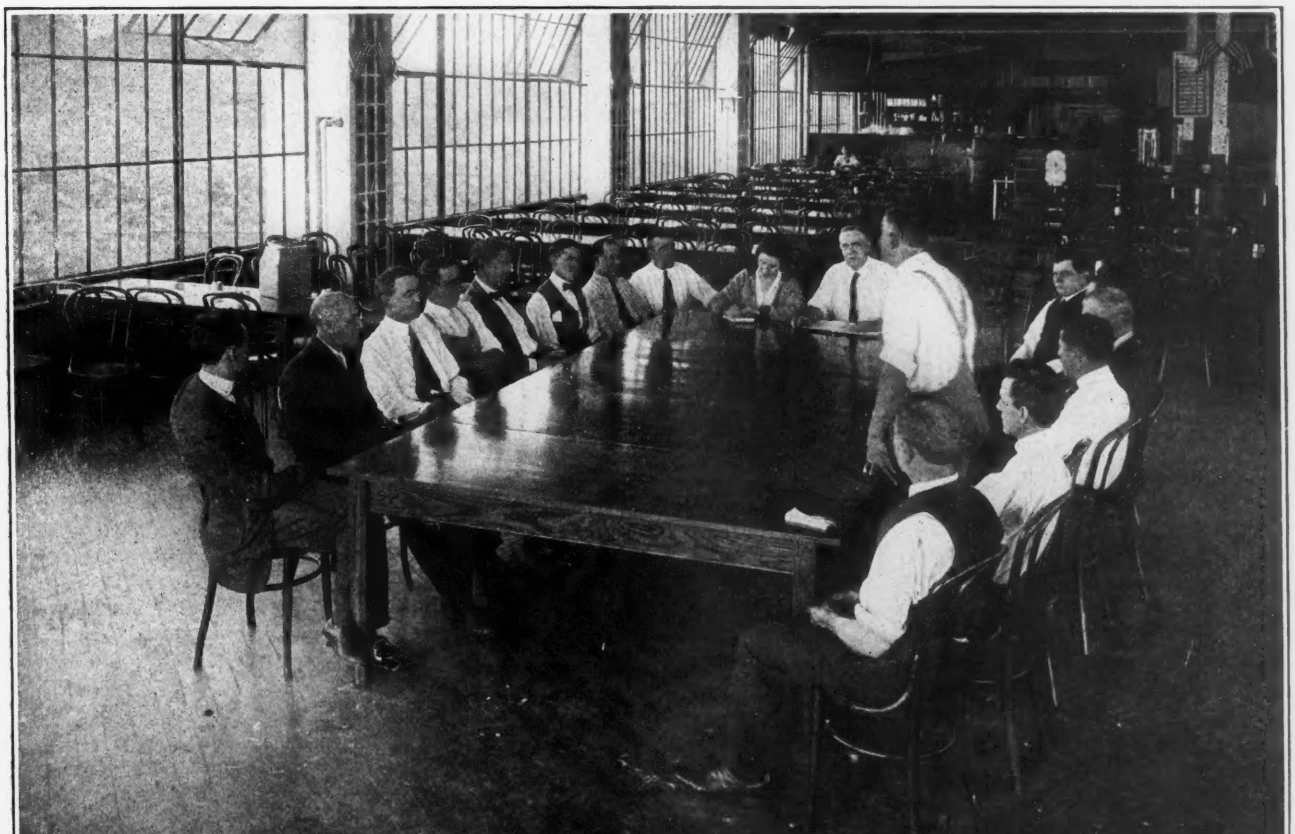
The improvement of manufacturing methods is not confined by any means to the ideas which originate at the meetings of the governing bodies. It is recognized that any employe may possibly, as a result of his experience and observation or by reason of natural ability, be able to suggest changes and improvements of commercial value; and to encourage the suggestion idea, prizes are awarded. These suggestions are placed in a box (unsigned, to avoid charges of favoritism), and the rather delicate task of deciding which ones are practicable and worth a prize is in charge of a suggestion committee. Incidentally, in one plant where this plan has been adopted, a certain suggestion from an employe was estimated to be worth $100,000.

Occasionally mass meetings of all the employes are held, but these are not often required because anyone in the plant can have his or her representative bring before the Senate or House any matter which is considered important.

What Happens to Wages?

Any mention of the labor problem naturally suggests the question of wages. When employes are asked to assume in part the burden and responsibility of management, what happens to wages? At the plant of the Passaic Metal Ware Co., wages were comparatively high before the introduction of the representative form of government, but they have been increased for the reason that production has also increased. The plan is to share equally with the employes the savings that may result from better teamwork under the new plan of management. The relative saving on the unit cost of production is the basis on which the savings are computed. When the general trend of wages and prices of raw materials is upward, if the cost of production has not risen proportionately, the net gain represents what has been saved. These savings are paid every two weeks, and are distributed as dividends on each employe's wage. The wage-percentage plan is considered more just than an equal distribution, because it is assumed that an experienced worker, upon whose vigilance and skill may depend the value of expensive products, should receive more of the savings than, for example, an inexperienced boy, for the reason that the skilled worker receives more wages, which he does because he is more valuable, holds a more responsible position, and renders a greater service. It will be noted that 50 per cent of the savings goes to the employes. This is considered fair by the employes who recognize that production costs are reduced by the chief executives as well as by the men under them, although the very active part taken by the workers in the improvement of manufacturing methods shows what can be accomplished when a man believes that his opinion is respected and feels that he is working *with* the company and not simply *for* it.

It is not in accordance with the business principles upon which this form of shop management is based to disregard existing wage scales when industrial democracy is introduced, and invite the men to adjust the wage question to suit themselves. That would obviously be an unsound policy, and would result in undermining the financial foundation beneath the business structure, so that everyone would lose eventually. However, regulation of wages, as well as changes in working hours, may be advocated by the Senate and House of Representatives; and according to the experiences in dif-



The Senate of the Passaic Metal Ware Co. in Session—The Senate is composed of the Foremen, the Heads of Departments, and Supervisors

ferent plants, the tendency has been to deal fairly with these matters. Wages have been increased when it has been the only just course, and in a number of instances they have been decreased voluntarily. The fact that the members of the Senate and the House view expenditures of the company's money in much the same way as though the transaction were of a personal nature, shows that the men feel a sense of responsibility and realize that the existence of the business depends upon reasonable production costs.

Advantages Claimed for the Representative System of Management

The principal advantages claimed for industrial democracy are: (1) an increase in the quality as well as in the quantity of the product; (2) the elimination of waste, both as to effort and material; (3) a lower production cost; (4) the elimination of strikes; and (5) a decided decrease in labor turnover.

The tendency is to improve the quality of the manufactured product, since rejected parts diminish the dividends; and the making of goods of quality is good business. The quantity is increased because there is an incentive for everyone to work—an incentive that is more potent than money alone. The production costs are certain to diminish when the experience of practically the entire organization is centered on the various details which determine whether a plant works smoothly or not, and frequently no one is better qualified to smooth out the wrinkles than the man who is closest to the particular work which is not quite up to the standard. Industrial democracy puts "the whole man on the job."

Now as to strikes: Can it be possible that there are no serious labor troubles? That has been the experience wherever the industrial democracy plan has been adopted. This plan is not antagonistic to labor unions; in fact, men are encouraged to join unions if they care to, and urged to take the constructive parts of industrial democracy and apply them to the union idea. Strikes, however, are not likely to occur when the workers are contented and know that they are getting a square deal. When the employer and employe are competitors and each tries to drive the hardest bargain possible, it is easy for the professional labor agitator to start trouble; but when there is a feeling of cooperation and partnership and a complete understanding, there can be no misunderstanding, and misunderstanding is the basis of all strikes. A well run union dovetails into industrial democracy as a glove fits the hand, but the professional agitator of Bolshevik principles has nothing to offer which is superior or even equal to what is obtained as a result of the plan of administration where justice, cooperation, energy, economy, and service are the principles which govern the activities of the whole organization.

The meaning of the term "labor turnover" has been almost forgotten at the Passaic Metal Ware Co.'s plant; in fact, this plant has the reputation of being a most desirable place in which to work, because the plan which grants to each man the right of self-expression makes him feel that he has a proprietary interest in the business. When these facts become known, others desire to join the organization.

It is understood, of course, that under this plan of management, the foremen have full authority to give orders, and these are obeyed without argument. If a workman believes that the foreman has been unjust, his grievance is investigated at the proper time, and full justice is given him; but arguments are not tolerated, and discipline, which is essential in any well-managed organization, is voluntarily maintained.

The General Principle upon which this System is Based

The remarkable success which has resulted from the application of democratic principles to factory administration is not possible unless an honest effort is made both by employers and employes to deal fairly with one another; and the company must prove its sincerity by giving the "big 50" and giving it first. In every such instance the men have shown themselves willing to readily cooperate and to do their share, but the "50-50" basis is one of the fundamentals of industrial democracy. A visitor entering the plant of the Passaic Metal Ware Co. will notice two American flags and the graphic representation of industrial democracy beneath them, which has for its cornerstones Justice, Cooperation, Economy, and Energy, with Service as a capstone. These basic principles have been adopted both by the executives and the employes as the only certain foundation upon which to build a business structure that is to endure and serve the best interests of all, and all have promised to uphold them.

General Conclusions

The experience of employers has been that granting the employe means of self-expression and a measure of self-government does not, in practice, weaken authority, or disrupt the organization, but strengthens it. "Authority," in its commonly accepted sense, gives way, in part at least, to cooperation. As explained in Mr. Leitch's book, "Man-to-man," industrial democracy represents "*a change in spirit* and not a change in the relative rights of ownership." Evidently, there has been some misunderstanding in regard to this point, as indicated by the following quotation from an editorial in an industrial journal:

"The theory of industrial democracy appears to be that by turning over a business to be directed in part, at least, by the workers, and by paying them a substantial bonus as profit-sharing or dividends, you will inspire a greater enthusiasm which will help the business. You start with a false premise if you accept this idea of the best method of creating an industrial democracy and you ignore the positive and absolute facts. You recognize not industrial democracy but industrial socialism, and you are simply taking one step in the direction of complete socialism. Socialism preaches the division and distribution of all property, and when you set up a condition where the owner of property is deprived of the right to manage it, you are merely one step away from the distribution idea which will follow later."

An investigation of this system of management as it is actually applied will show that it does not deprive the property owner of the right of management, but places the management upon a more secure footing. It assures teamwork by all; it banishes misunderstandings and grouches; it puts the whole man on the job and he works with head, heart, and hand. The owner, either directly or through executives representing him, and the employes cooperate and give the full benefit of their combined experience to the organization, because real cooperation is known to be good business policy. The owners or executives become friends of their men, and the men, friends of the executives. Industrial democracy is a satisfactory working agreement, and those who have first-hand knowledge of it consider it a practical solution of the problem of a fair and equitable basis of harmonious understanding between the employer and the employe.

* * *

SAFETY IN THE STEEL INDUSTRY

The steel industry has emerged from the extremely hazardous class of occupations; at least this is the conclusion that may be drawn from the fact that the largest and most conservative insurance companies in the country have announced a radical downward revision of the extra premium rates charged for insurance on the lives of workmen in the steel industry because of the supposedly hazardous nature of their occupations. In the past, blast furnace, Bessemer plant, open-hearth plant, crucible steel plant, and rolling mill employes have been paying a considerable extra rate in addition to the regular life insurance rate. At present, these extra rates are entirely abolished in two instances and reduced to from one-third to one-fifth of the rates of 1908 in all other cases. This is one of the most interesting indications of the remarkable effect that the safety-first movement has had in the steel industries.

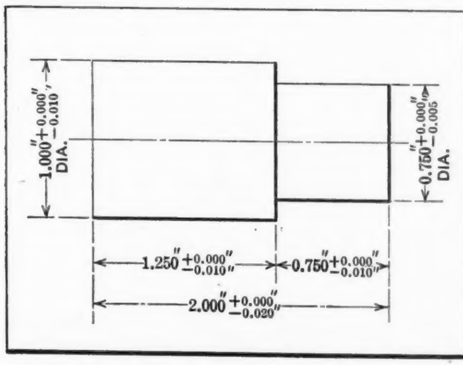


Fig. 1. Common but Incorrect Method of Dimensioning

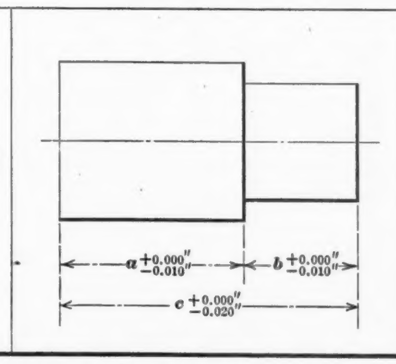


Fig. 2. One Interpretation of Dimensioning in Fig. 1

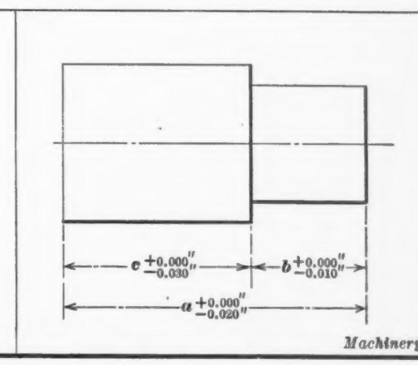


Fig. 3. Another Interpretation of Dimensioning in Fig. 1

Component Drawings for Interchangeable Manufacture

First of Two Articles on Methods of Dimensioning Drawings and Indicating Tolerances

By EARLE BUCKINGHAM, Engineer, Pratt & Whitney Co., Hartford, Conn.

THE art of expressing mechanical information by means of drawings is still in the process of evolution. Many details have become conventionalized, yet these comprise little more than the alphabet of the language of drawings and relate principally to conventional meanings of the lines, figures, and relative locations of the several projections which go to complete the drawings. Such, for example, are the full lines which represent the visible outlines of the part; the dotted lines which represent the hidden outlines; the light dot-and-dash lines which indicate center lines; the light dimension lines—and all the other conventional lines and characters which are employed. The third-angle projection is also fairly well established in mechanical drawing. This branch of drawing is fully covered in text-books, so no further mention of it will be made here. The subject of dimensioning, however, is so incompletely covered that this article will be devoted to a detailed discussion of this subject. The addition of tolerances on component drawings has created new problems which have not, as yet, been fully solved, and which, therefore, require considerable and thoughtful study.

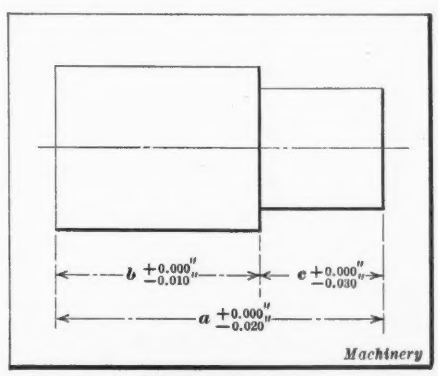


Fig. 4. A Third Interpretation of Dimensioning in Fig. 1

The matter of dimensioning, as given in books and taught in various schools, receives only minor attention. Little more than the a b c of the subject is taught. In actual practice—particularly where tolerances are involved—so many different conditions are to be met, so many different shades of meaning must be clearly expressed, and so many different types of workmen must be informed by these drawings that this alphabet must be fully understood and carefully used to enable it to serve its purpose. It is necessary, in order to consider intelligently this subject of dimensioning with tolerances to discard all school training in the application of dimension lines, etc.

The main purpose of a mechanical drawing is to express or record information. This information is of many kinds and is used for many purposes. The drawing, to be correct, must clearly and consistently express the particular information required to serve its specific purpose. For example, a type of drawing that may be correct for the use of a toolmaker in building a jig, may be incorrect for the use of a machine operator in the manufacturing department engaged in quantity production. Inasmuch as the drawings are the written or pictured expression of the design, they may be roughly classified into functional drawings and manufacturing or component drawings.

Functional Drawings

The functional drawing, like the functional design, primarily expresses the functional conditions to be maintained. The detailed information relating to many of the manufacturing problems that are involved which does not appear on these drawings is supplied by the mechanic who uses them. Thus, in those cases where only a few special mechanisms, or jigs, fixtures, tools, etc., are to be made in a general machine shop or toolroom, where the type of workman is such that this detailed information is unnecessary, functional drawings only are required. Such drawings need not express tolerances, clearances, and other minor details so essential on the manufacturing drawings. For example, a notation such as "drive fit" or "sliding fit" is sufficient to indicate and obtain the desired results. Yet, even here, if the drawings are to serve their purpose

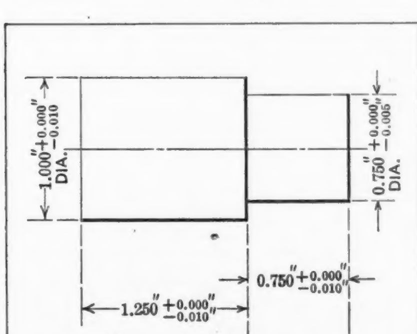


Fig. 5. Correct Dimensioning if Length of Body and Length of Stem are most Important

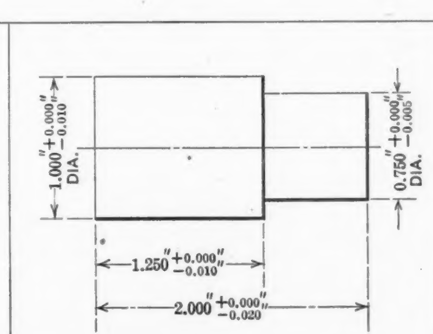


Fig. 6. Correct Dimensioning if Length of Body and Over-all Length are most Important

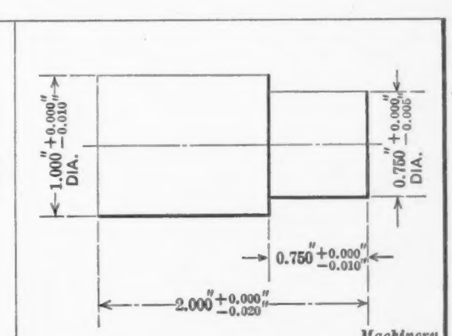


Fig. 7. Correct Dimensioning if Over-all Length and Length of Stem are most Important

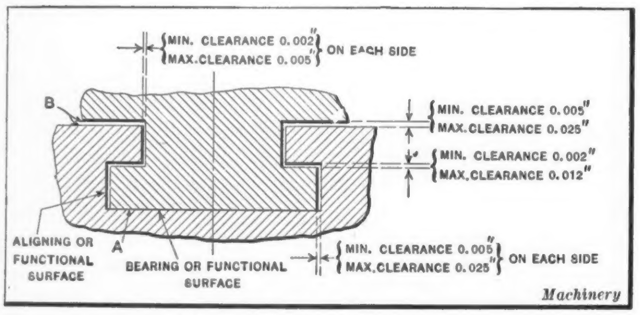


Fig. 8. Sketch showing Functional Requirements of Slide

efficiently, the information given must be so expressed that it may be used directly. In order to attain this end, every line drawn and every dimension expressed must be made with a full understanding of the final results required and of the means to be employed to obtain them.

Manufacturing Drawings

The manufacturing drawings, to be complete, must express all suitable information that is available. For the purposes of the present discussion, we will confine ourselves to component drawings of an interchangeable product. As stated in a preceding article, the proper dimensioning of component drawings with tolerances is a mathematical problem. Five laws are given, which, if carefully observed, will simplify many of the equipment and production problems.

Laws of Dimensioning

1. In interchangeable manufacturing there is only one dimension (or group of dimensions) in the same straight line which can be controlled within fixed tolerances. This is the distance between the cutting surface of the tool and the locating or registering surface of the part being machined. Therefore, it is incorrect to locate any point or surface with tolerances from more than one point in the same straight line.

2. Dimensions should be given between those points which it is essential to hold in a specific relation to each other. The majority of dimensions, however, are relatively unimportant in this respect. It is good practice to establish common location points in each plane and to give, as far as possible, all such dimensions from these points.

3. The basic dimensions given on component drawings for interchangeable parts should be, except for force fits and other unusual conditions, the maximum metal sizes. The direct comparison of the basic sizes should check the danger zone, which is the minimum clearance condition in the majority of cases. It is evident that these sizes are the most important ones, as they control the interchangeability, and they should be the first determined. Once established, they should remain fixed if the mechanism functions properly and the design is unchanged. The direction of the tolerances, then, would be such as to recede from the danger zone. In the majority of cases, this means that the direction of the tolerances is such as will increase the clearance. For force fits, such as taper keys, etc., the basic dimensions determine the minimum interference, while the tolerances limit the maximum interference.

4. Dimensions must not be duplicated between the same points. The duplication of dimensions causes much needless trouble, due to changes being made in one place and not in the others. It causes less trouble to search a drawing to find a dimension than it does to have them duplicated and more readily found but inconsistent.

5. As far as possible, the dimensions on companion parts should be given from the same relative locations. Such a procedure assists in detecting interferences and other improper conditions.

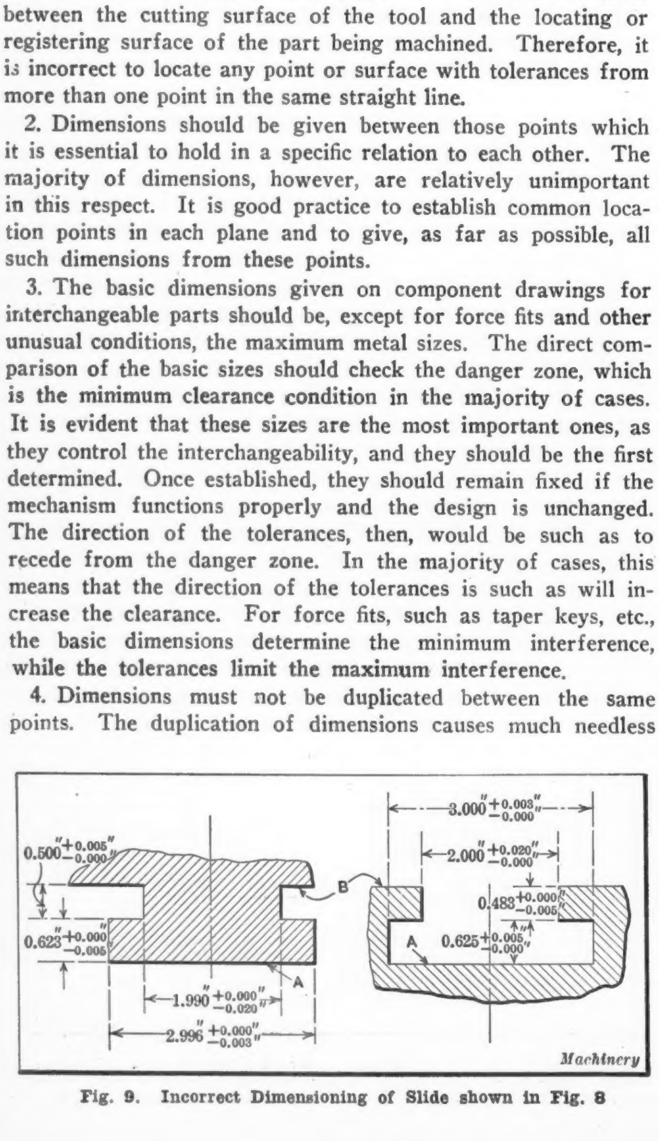


Fig. 9. Incorrect Dimensioning of Slide shown in Fig. 8

When attempting to work in accordance with general laws or principles, one other elementary rule should always be kept in mind. Special cases require special consideration. This may be another method of saying that the exception proves the rule. The following detailed examples are given to illustrate the application of these five laws and to indicate results of their violation.

Violation of First Two Laws

For the first example, we will take the stud shown in Fig. 1. This shows a very common method of dimensioning such a part, but one that is extremely bad practice. It violates the first and second laws given above. As the dimensions given for the diameters are correct, they are eliminated from the discussion. The dimensions given for the various lengths are wrong: first, because they give no indication as to the essential lengths; second, because of several possible sequences of operations, some of which would not maintain the specified conditions. Composite surface conditions are created, whereas they should be kept elementary.

Fig. 2 shows one possible sequence of operations indicated alphabetically. If we first finish the dimension *a* and then finish *b*, the dimension *c* will be within the specified limits. In this case, however, the dimension *c* is superfluous. Fig. 3 gives another possible sequence of operations. If we first establish *a*, and then *b*, the dimension *c* may vary 0.030 instead of 0.010 inch as is specified in Fig. 1. Fig. 4 gives a third possible sequence of operations. If we first finish the over-all length *a*, and then the length of the body *b*, the stem *c* may vary 0.030 inch instead of 0.010 inch as specified in Fig. 1.

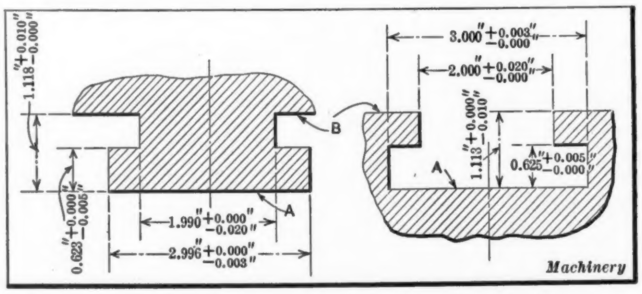


Fig. 10. Proper Dimensioning of Slide shown in Fig. 8

If three different plants were manufacturing this part, each one using a different sequence of operations, it is evident from the foregoing that a different product would be received from each plant. The example given is the simplest one possible. As the parts become more complex, and the number of dimensions increase, the number of different combinations possible and the extent of the variations in size that will develop also increase.

Fig. 5 shows the correct way to dimension this part if the length of the body and the length of the stem are the essential dimensions. Fig. 6 is the correct way if the length of the body and the length over-all are the most important. Fig. 7 is correct if the length of the stem and the length over-all are the most important.

If the part is dimensioned in accordance with either Fig. 5, Fig. 6, or Fig. 7, the product from any number of factories should be alike. There is now no excuse for them to misinterpret the meaning of the drawing. The point may be raised that the manufacturer should study the drawing to determine what his sequence of operations should be in order to maintain all dimensions and tolerances given. On such a simple part as was given for the first example, this would not be difficult. On a more complicated piece, however, it would be almost

impossible. Such conditions occur when the draftsman makes little or no effort to reduce as many surfaces as possible to elementary ones. Furthermore, when the manufacturer or workman sees such dimensions on a component drawing, he is justified in assuming that the designer or draftsman who made them had little or no idea as to the essential conditions to be maintained. In such cases, the sequence of operations and the register points for machining will be established to facilitate production, or to suit the ideas of individuals as to the most essential conditions. Often, this will result in some of the operations on a component being arranged to suit one idea, while the remainder are completed in accordance with an almost diametrically opposed conception. It cannot be too strongly impressed upon the draftsman that when a drawing leaves his hands it must not be open to more than one interpretation. This, in turn, demands that a uniform method of interpretation be adopted and published by each plant for the guidance of all concerned. It is self-evident that a universal method of interpretation of drawings with tolerances would be of great benefit to all manufacturing plants. This is a field where the various engineering societies, working in close co-operation, could render valuable service.

Violation of the Second Law

Let us take as the second example the slide shown in the sub-assembly, Fig. 8. This sketch gives the functional conditions which must be maintained. It is well to note that it is a

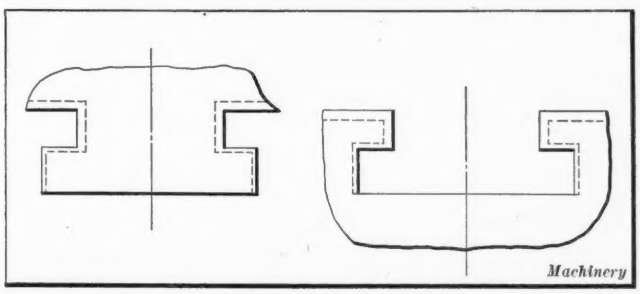


Fig. 11. Graphical Illustration of Application of Tolerance

very desirable practice to add to a set of component drawings a series of sub-assemblies of this kind. These would show graphically the functional requirements of the most important operating members of the mechanism, when the detail drawings are insufficient, in themselves, to express them clearly. Such a practice will prove of great assistance in limiting the interpretation of the component drawings.

Fig. 9 illustrates a common method of dimensioning such details. This is wrong, as it violates the second law previously stated. These parts are dimensioned in Fig. 10 in accordance with the foregoing laws. It will be noted that all dimensions for height are given from the bearing surface *A*, which is the most important in this case. If the slide should be designed to bear at *B* instead of at *A*, surface *B* would become the most important, and the various dimensions of height would be given from there instead of from *A*. The same functional conditions (see Fig. 8) are maintained in Figs. 9 and 10. Attention is called to the fact that in Fig. 10 it is possible to allow a tolerance of 0.010 inch on the dimension to the top surface *B*, whereas in Fig. 9 only 0.005 inch can be allowed as a manufacturing tolerance when making this cut.

Thus, the improper and careless dimensioning of component drawings results directly in reducing the manufacturing tolerances, in addition to creating uncertainty by not indicating the essential surfaces. Furthermore, the possibility of draftsman's errors is greatly increased by dimensioning as shown in Fig. 9 because the draftsman, in this case, must make several additions and subtractions of basic figures and tolerances in order to check the maximum and minimum clearances. In Fig. 10, on the other hand, the direct comparison of the basic dimensions checks the minimum clearance. The maximum clearance is readily checked by adding the sum of the tolerances to this minimum clearance. In general, the direct comparison of the

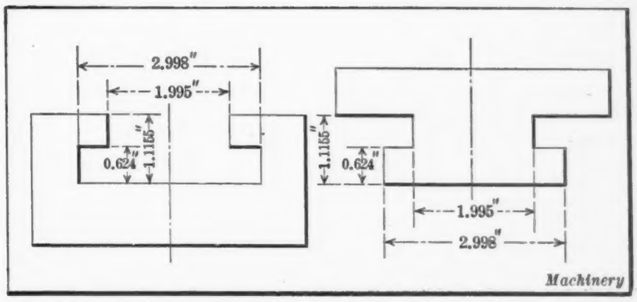


Fig. 12. Dimensions for Functional Gages for Part shown in Fig. 10

basic dimensions should establish the minimum clearances between elementary surfaces on companion parts.

No mention has been made of the dimensions of width in the previous example. Strictly speaking, dimensions so given are central with the center line. Half of the tolerances for width may be utilized on either side of the center line. This does not mean that the surfaces must be absolutely central; one side can be made to the maximum dimension and the other side to the minimum. In general, the tolerances should be understood to establish a parallel zone of acceptable work, all parts falling within this zone being acceptable. Fig. 11 illustrates how the dimensions and tolerances in Fig. 10 establish such a zone. The full lines show the basic or maximum metal conditions, while the dotted lines show the minimum metal conditions.

In the previous example, each surface has been considered as an independent elementary surface, and the meaning of the drawing interpreted accordingly. But there is also a certain condition of alignment which these various surfaces must maintain in relation to each other. When considering this phase of the subject, the surfaces become composite. Whenever composite surfaces are involved, the functional requirements of these surfaces must be taken into consideration. The only satisfactory method of solving such problems is in terms of the inspection gage requirements. If the succeeding solutions are accepted, the accompanying interpretations, expressed in terms of functional gages, must also be accepted.

To a certain extent, the amount of tolerance required to machine a given surface depends on the methods employed to check the results obtained. For example, the maximum thickness of the tongue of the slide shown in Fig. 10 is 0.623 inch. If this thickness is checked with an ordinary snap gage, practically the entire tolerance is available for variations in thickness. If, however, the width of this snap gage were equal to or greater than the length of the tongue, any deviations in the surfaces checked from true parallel planes would tend to prevent the part from entering the gage. In this case, part of the tolerance would be consumed by the errors in alignment of the two surfaces, leaving the remainder for variations in the distance between them.

One of the principal reasons for providing clearances in the design is to discount this condition of misalignment. Therefore, in developing functional gages to check these conditions, we are justified in utilizing a fair percentage of the minimum clearance. In order to insure strict interchangeability, the functional gage for the male component should never be larger than the functional gage for its companion female component. In general, if the functional gages never invade this minimum clearance more than fifty per cent, we shall remain on the

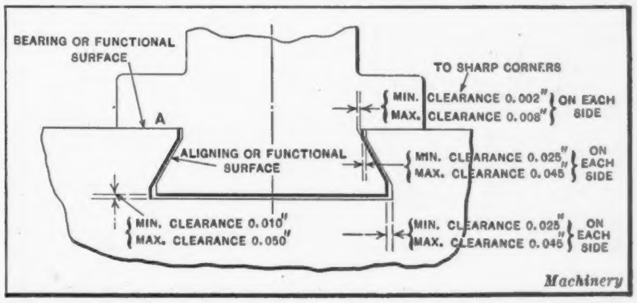


Fig. 13. Sketch showing Functional Requirements of Dovetail Slide

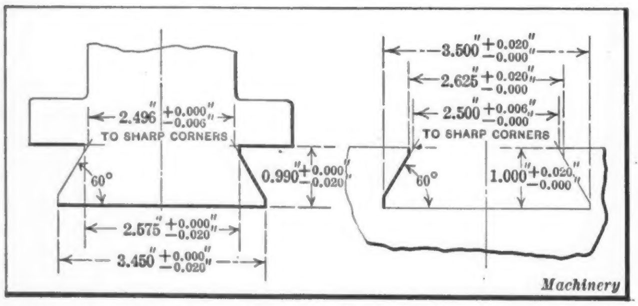


Fig. 14. Correct Dimensioning of Dovetail Slide shown in Fig. 13

safe side. Conditions sometimes arise, of course, where it is desirable to utilize a greater percentage on one component and a correspondingly lesser percentage on the other. For the purposes of this discussion, however, we shall assume that the conditions are such that a maximum of fifty per cent for each component represents a fair distribution.

The dimensions for functional gages to check the parts shown in Fig. 10 are given in Fig. 12. The various dimensions of the parts should first be checked as elementary surfaces with limit gages representing the specified limits. This functional gage would then be employed to test the relative alignment of these surfaces necessary to insure interchangeability.

Dimensioning Composite Surfaces

Thus far we have been considering parts whose surfaces are susceptible of individual checking as elementary surfaces. We must also consider parts whose surfaces cannot be resolved into elementary ones and checked as such. Take, for example, a dovetail slide, such as shown in Fig. 13, which introduces an angular surface. Such angular surfaces are almost always composite ones. Great care must be exercised in such cases to avoid compound tolerances.

A compound tolerance exists when the application of a tolerance on one dimension develops a variation in another dimension which also has a tolerance specified. Such a condition immediately raises the question as to whether the resultant variation of both tolerances is permissible or whether the tolerances specified are final and complete for their respective dimensions. In either event, confusion and misunderstanding will result. Here, as with the introduction of more than one dimension in the same straight line (see first law of dimensioning) to locate a given surface, the final results will depend on the sequence of operations adopted, with all the attendant differences. As stated in the article "Principles of Interchangeable Manufacturing," in the July number, in making component drawings, the effort should be made to so give the dimensions and necessary tolerances that it would be possible to lay out one—and only one—representation of the maximum metal condition and one—and only one—minimum metal condition. If such lay-outs were superimposed, the difference between them would represent the permissible variation on every surface. If a few such lay-outs are made, it will soon be evident that there are always a number of dimensions that should be given without tolerances.

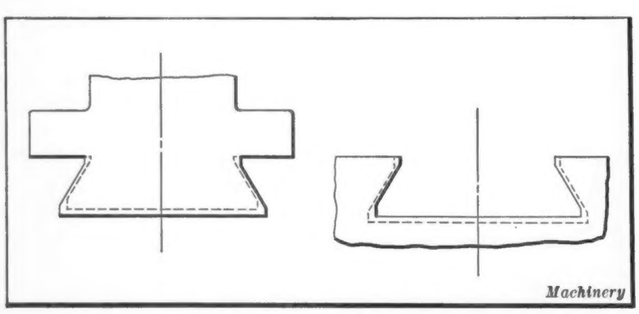


Fig. 15. Graphical Illustration of Application of Tolerances

A compound tolerance is an error—often a serious one. It can and should always be eliminated. Fig. 14 illustrates a method of dimensioning the dovetail slide shown in Fig. 13 which avoids compound tolerances. The dimensions that control the position of the angular flanks are given to the sharp corners at the top of the dovetail. The tolerances on these dimensions limit the permissible variation of these angular flanks. The angle is given as a flat dimension. As is evident from the functional drawing, Fig. 13, the bearing surface *A* and these angular flanks are the essential functional surfaces of this dovetail. All other surfaces are clearance surfaces, as should be apparent from the extent of the tolerances, Fig. 14, even though the functional drawing were not available. Fig. 15 shows graphically the applications of the tolerances given in Fig. 14. The full lines represent the maximum metal conditions, while the dotted lines indicate the minimum metal conditions.

Compound Tolerances

The dimensioning of tapered plugs and holes introduces a somewhat similar problem which will result in a condition of compound tolerances if great care is not exercised. Fig. 16 shows such a tapered hole as it is usually dimensioned. This method of dimensioning is wrong, as it creates a condition of compound tolerances. With these dimensions, it is impossible to determine what final result is required, since there are so many possible combinations. It is evident that as the diameter of either the large or the small hole varies, the taper will change. This makes an uncertainty about the reamers, as these tools have a fixed taper. If we assume that the taper is constant, questions will be raised as to which combination of limits to employ to establish the taper. If we further assume that the basic dimensions are to be used for this purpose, the next question will be whether this taper, considered as a constant, is required to remain in the position indicated by the dimension 1.000 inch $^{+0.010}_{-0.000}$ under all conditions, or whether it can also vary in addition by the amount resulting from the variations in diameters. Also a tolerance is given on the length of the taper. This is entirely meaningless. It cannot be measured readily even with an elaborate laboratory equipment and there is no use for this tolerance in the course of manufacture. With a fixed taper, the variation in this length is controlled absolutely by

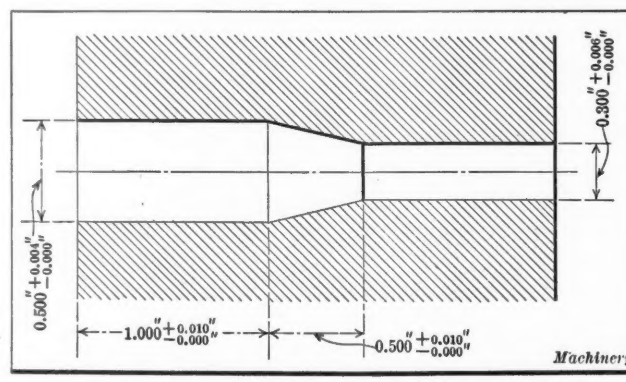


Fig. 16. Incorrect Method of dimensioning Tapered Hole

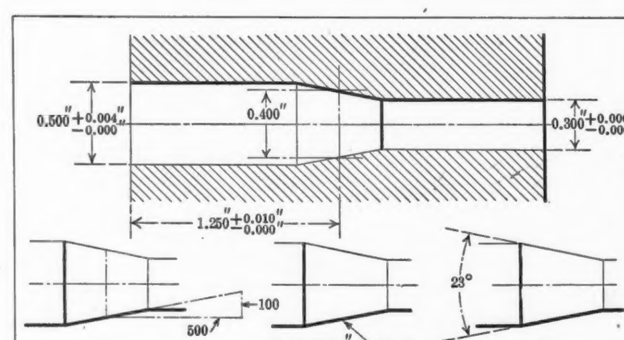


Fig. 17. Correct Method of dimensioning Tapered Hole

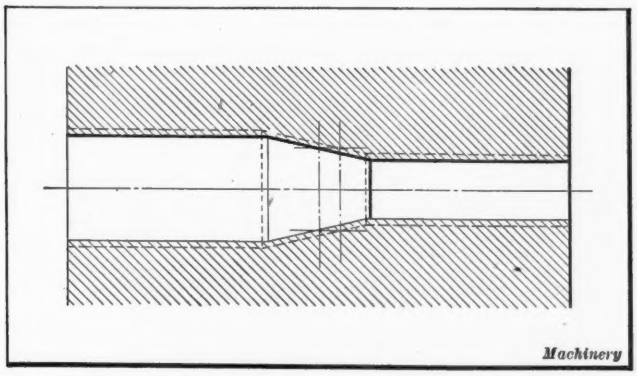


Fig. 18. Graphical Illustration of Application of Tolerance

the relative sizes of the holes. All in all, as the drawing stands, it is a puzzle without any solution.

We will assume that the intent of Fig. 16 is to indicate a constant taper with a tolerance of +0.010 inch in regard to its position. Fig. 17 shows the correct method of dimensioning such a surface to maintain such a condition. An arbitrary point is taken on the taper and a fixed dimension given for its diameter at that point. The location of this fixed diameter is dimensioned with the tolerance. Three methods of dimensioning this taper are shown. Either of the first two, *A* or *B*, is preferable to the third, *C*, because any reference figures desired can be readily computed from them without recourse to trigonometry or any tables or handbooks.

Fig. 17 gives the manufacturer definite information which he can use and which he can use in only one way. The tolerances given on each dimension apply only to the specific surface in question. No tolerance can be given on the diameter of the taper nor on the angle without introducing compound tolerances again, with resultant confusion. The permissible variations on this tapered surface are fully established by the tolerance given on its location. Fig. 18 shows graphically the maximum and minimum metal condititions established by the dimensions and tolerances given in Fig. 17. It will be noted that a parallel zone for the permissible variations has been established on every surface. When this has been accomplished, no further tolerances should be given.

The method of dimensioning a taper shown in Fig. 17 usually meets with more or less opposition from the shop men. The objection is raised that more dimensions are necessary in order to make up the proper reamers, etc. Although the needed dimensions can be readily computed, it is desirable to reduce the amount of such computations in the shop as much as possible. This objection can be eliminated in several ways. First, if a drawing is made for the reamers, all the additional checking dimensions can appear on these drawings. Second, if operation drawings are provided, these dimensions would appear there. Third, if neither of the two foregoing practices is adopted, the required dimensions may appear on the component drawing in parentheses, and may be marked "Basic" or "Reference." It should be clearly understood, however, that such dimensions are supplementary and apply only in connection with the other basic dimensions given. No tolerances should under any circumstances be given on such reference figures. As far as possible they should be eliminated from the drawing.

* * *

INTENSIFY PRODUCTION

An eight-hour day and a living wage—it is a good slogan. A living wage should mean more than a wage that merely feeds and clothes and houses. It should mean a wage that makes living healthful, comfortable, and happy. But if that is to be true, then an eight-hour day must mean a day of honest labor, in which the worker's full capacity for production is exercised without arbitrary restraint. This lesson must be driven home upon organized labor. It is fundamental. Only what is produced by the combined efforts of capital and labor can be divided between them.

To demand a shorter day and higher wages means that labor must produce more than it has been producing and in less time. It is easily possible, if arbitrary restrictions are abolished upon the quantity of work a man may do in a given period. But if labor demands a shorter day, and then rules that the union man may do in that day only a fraction of the work he is capable of doing, it is creating a situation that must become impossible and will end in disaster.

Labor argues that by limiting the amount of work a man may do in a day it can multiply the job opportunities for workers. But that argument is only superficially true. It should be obvious that if 100 men produce only as much as 75 could produce, each of the 100 must get a smaller share than each of the 75 would be entitled to. But labor not only wants to use 100 men to do the work of 75; it wants also that each of the 100 should be paid as much as each of the 75 can earn. It cannot be done.

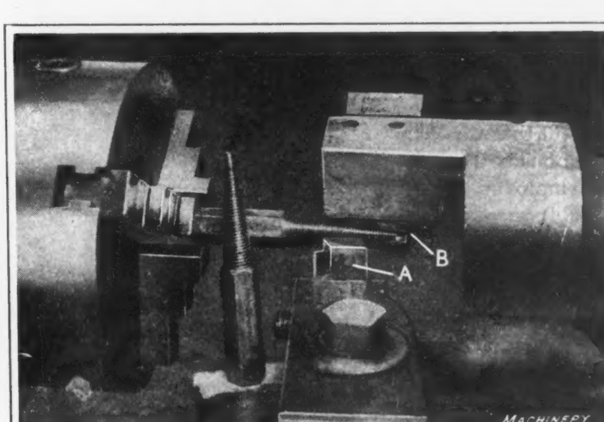
Increase production and the purchasing value of the dollar will increase with it. If this be not done sooner or later, we will run into trouble more serious than any we have yet seen. For a time the 5,000,000 organized workers of the United States who are pushing wages higher and higher may be able to sustain the high-price structure that is being reared simultaneously. But they cannot sustain it indefinitely. Presently, the decreased consumption of many millions more of unorganized workers is going to be felt, and the structure will collapse.—From an editorial in the *Chicago Evening Post.*

* * *

THREADING TAPERED SPINDLES

The illustration shows the method employed by the S. A. Potter Tool & Machine Works, New York City, for threading tapered spindles which are made from 5/8-inch hexagonal cold-rolled steel bars. The spindles taper from 5/8 to 1/8 inch in diameter, the length of the tapered end being 2 1/4 inches. The first operation in machining these spindles is performed on a Cleveland automatic screw machine and consists of turning the tapered end and cutting the piece from the stock to the correct length of 4 1/4 inches. The threading operation is performed on an engine lathe, the hexagonal end of the spindle being held in a three-jaw chuck. A Landis thread chaser *A* is used to generate the threads, the chaser being held in a specially designed toolpost. The tapered end of the spindle is supported during the cutting operation by the V-block *B*, which may be adjusted to suit the spindle. This V-block is attached to the under side of a special fixture which has a tapered shank that is held in the tailstock spindle.

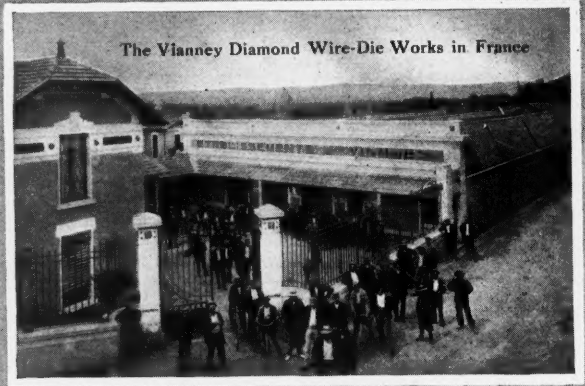
This has proved an efficient and rapid way of producing these spindles. The chaser cuts smoothly, frequent grindings are not required, and only four revolutions of the work are necessary to permit the chaser to cut the full depth of the threads. By this method an average of 100 spindles per eight-hour day has been produced, on an open-belt machine operated by unskilled help. A. B.



Method of using Landis Chaser for cutting Taper Threads

Making Diamond Wire-Drawing Dies

Edward K. Hammond



The Vianney Diamond Wire-Die Works in France

Preparing, Setting and Refinishing Diamond Dies

DIAMOND dies are quite extensively used for drawing small wire made of all kinds of metal. They are now employed almost exclusively for sizes ranging from 0.080 inch down to 0.0004 inch in diameter; and owing to their durability and other advantageous features, diamond dies are now finding quite a wide application for drawing larger sizes of wire. When they are properly made, the use of these dies is an economical practice. Although their first cost is high, diamond dies retain their accuracy for a long time and they can be repeatedly recut, so that the item of die cost which must be charged against the expense of manufacturing wire, is distributed over a very large quantity of the product and becomes almost a negligible factor. For this reason, diamond dies have largely replaced the use of dies made from steel, iron, ruby, or sapphire. Most diamond dies are made of rough diamonds from the South African and Australian mines, the diamonds used for this purpose being of a grade which is unsuitable for use in jewelry. Diamonds from the mines are shipped chiefly to London, and from that market they are exported to different cities in France where the majority of the dies used in wire-drawing are made.

History of Diamond Dies

Trevoux, where the Vianney Wire-Die Works are located, is a small town in France on the Saone River a few miles above Lyons, the latter city being well known for its silk industry. Fine gold and silver wires are woven with silk for making various types of church decorations, military and naval epaulets, etc. Much of the gold and silver wire used for this purpose was produced by the Richard wire factory in Trevoux. The dies used for drawing this wire were made of rubies or sapphires until Joseph Vianney, who was employed in the plant, thought of making diamond dies, owing to the fact that diamond is harder than either ruby or sapphire. Their use proved so successful that they were soon universally employed in the gold wire industry and later, the application of diamond dies extended to plants manufacturing copper, brass, and steel wire. Today diamond dies are employed for making fine gages of wire from practically all metals; and their use has proved exceptionally valuable in drawing tungsten wire for the filaments of incandescent electric light bulbs. Stones weighing up to 20 karats are used for the purpose. Owing to their successful application in numerous lines of industry, M. Vianney organized the Vianney Wire-Die Works at Trevoux to engage in diamond die manufacture. This firm now has a thoroughly modern plant which is shown in the heading illustration of this article. From 75 to 100 expert diamond drillers and polishers are employed. All of the work of making Vianney diamond dies is done in France with the exception of the mounting, which is done at the New York offices at 1 Union Square, which are in charge of V. J. Boulin. Orders for refinishing diamond dies to a larger size can also be executed in the company's New York offices.

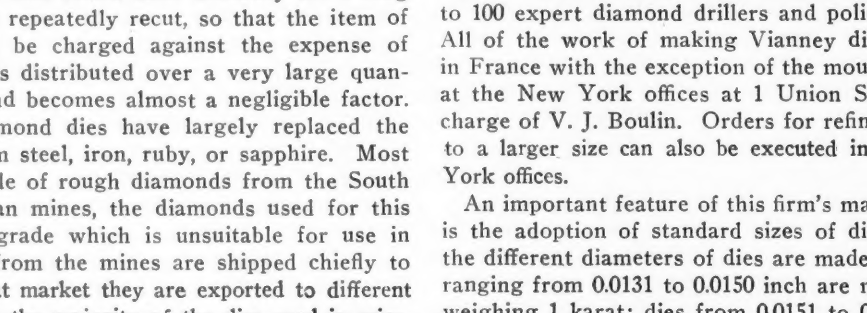


Fig. 1. Rough Diamond, Flattened Stone, Drilled Stone and Diamond Die mounted Ready for Use in drawing Wire

An important feature of this firm's manufacturing practice is the adoption of standard sizes of diamonds from which the different diameters of dies are made. For instance, dies ranging from 0.0131 to 0.0150 inch are made from diamonds weighing 1 karat; dies from 0.0151 to 0.0170 inch are made from 1¼ karat diamonds, etc. As a result of this standardization, the purchaser of dies made by this firm is able to buy any specified size at a uniform price, because the diamonds from which these dies are made are of the same weight. Such a practice in making diamond dies is only possible where a firm does a business of considerable magnitude, because it necessitates the purchase of large numbers of diamonds which may be sorted out into the various standard sizes to which reference has just been made. The unit of weight known as a "karat," which is ordinarily used in designating the size of diamonds, is equal to 200 milligrams or 3.086 grains troy.

Preparing Rough Diamonds

"Diamond cut diamond" has become a popular expression, as it is a matter of fairly general knowledge that diamond is the hardest material known to science, and that nothing can cut a diamond except another stone of the same kind. Consequently, the work of making diamond wire-drawing dies must be done by cutting the stones

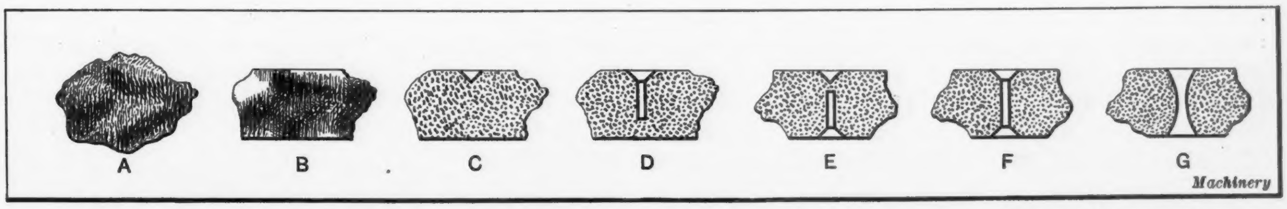


Fig. 2. Rough Diamond A and Cross-sectional Views showing Successive Steps in the Process of making Wire-drawing Die

with some form of diamond. The first step is to take a stone and flatten it on two opposite sides, in order to make provision for holding the diamond for subsequent cutting operations, and for setting it in the mounting after the cutting has been completed. This flattening of the diamond is done with laps charged with diamond dust, made by pulverizing small-sized diamonds, or chips from larger stones, and then grading this dust by sifting it through sieves with various numbers of meshes per square inch. This operation brings the stone to the condition shown at *B* in Fig. 2.

The first step in cutting the die opening is to chuck the diamond on the faceplate of a special drilling machine and cut a conical-shaped opening, as indicated at *C*. This opening is made by means of a diamond chip held by hand between the points of a pair of long-nosed pliers. The drilling machine is so designed that the table rotates and also has a vertical reciprocating motion imparted to it. After the conical hole has been cut, the drilling operation is started by means of a tool carried in the spindle of the machine. This spindle rotates in the opposite direction to the faceplate, and also has a reciprocating motion. It is important to note, however, that the reciprocal movement of both the table and drill is very slight. The term "drilling" is used to denote the work of making die-openings, although the cutting tool used for this purpose is more like a lap. It consists of a steel point that runs down into the conical-shaped opening *C* cut in the diamond after this opening has been filled with diamond dust mixed with oil. The tool pushes this diamond dust down into the opening, and as the tool rotates it carries the dust around with it and gradually produces the required hole.

After the hole has been drilled about three-fourths of the way through the diamond, as indicated at *D*, the work is removed from the machine and turned over, after which it is reset and a diamond chip held with a pair of long-nosed pliers is used to cut a conical opening in the opposite side of the diamond, as indicated at *E*. This opening is carefully located exactly opposite the hole which has been drilled in the work, and the next step is to drill from the bottom of this conical opening to make a connection with the hole entering the stone from the opposite side, thus bringing the piece into the form indicated at *F*. Those who are familiar with the business of wire-drawing, know that it is a matter of great importance to have the inside of the die absolutely smooth, in order to prevent forming seams in the work, and also that the bell-mouth of the die must be formed in such a way that the metal will pass into the die without undue frictional resistance. If there were a sharp edge between the bell-mouth and the throat or smallest sized opening in the die, there would be a great deal of frictional resistance in drawing the wire through, and satisfactory results could not be obtained.

The final cutting operation in diamond die making is to bring the die to the condition shown at *G*, for the reasons which have just been mentioned. It will be noticed from the cross-sectional views, that the inlet to the so-called "bearing" or throat of the die is made larger than the outlet at the back. This operation calls for the maximum skill on the part of the diemaker, and is always done by a man of wide experience. The cut is taken with a diamond chip held between the points of a pair of long-nosed pliers, and it will be evident that working in this apparently crude way, a great deal of dexterity is required to form the bell-mouth at each side of the die with a gradual curve coming tangent to the throat. After the die opening has been completely formed, the entire surface must be highly polished in order that frictional resistance of the wire passing through the die may be reduced to a minimum. Great care must be taken in making these dies, and even the most experienced workmen require from three to four days to make a die of average size.

Setting Diamond Dies

Diamond dies made by the Vianney Wire-Die Works are set in brass mounts which are made of blanks *A*, Fig. 3, cut from a cold-drawn brass bar. The die mounts are usually 1 inch in diameter by 3/8 or 1/2 inch in thickness. A socket is bored from one side of each of these disks, as shown at *B*, which is of sufficient size to receive the diamond; and then a central hole is drilled from the opposite side of the disk *C*, this hole being of the same size as the diameter of the wire which is to be drawn. After the diamond has been dropped into place in the socket, a small steel pin or mandrel is passed through both the drilled

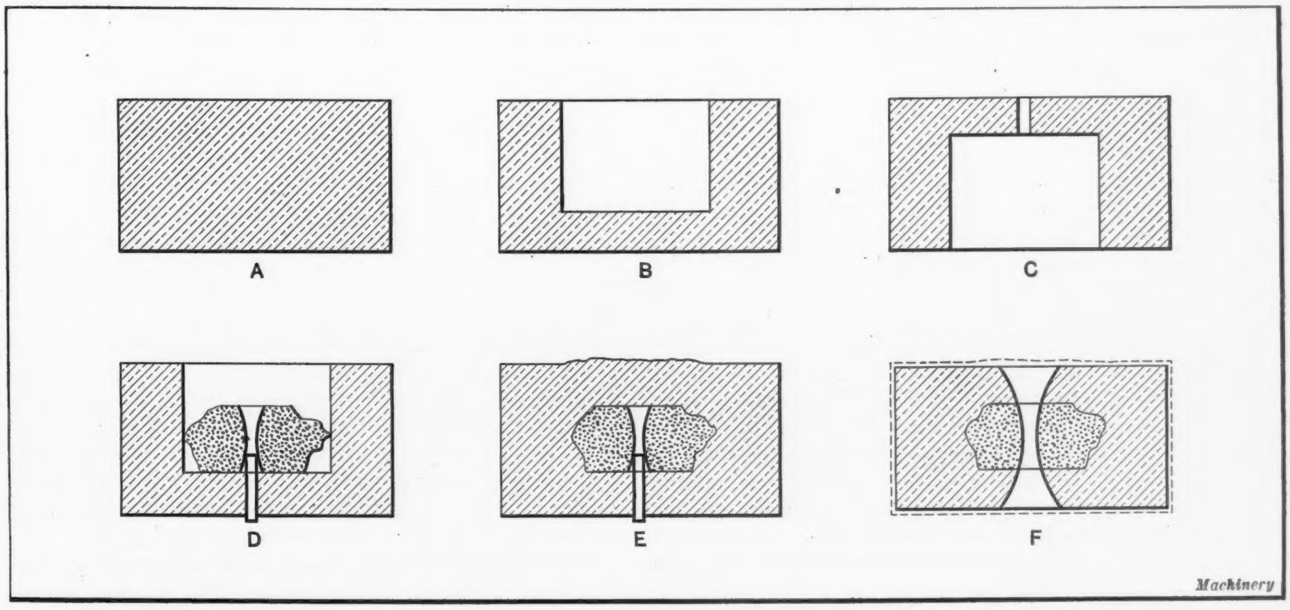


Fig. 3. Cross-sectional Views showing Successive Steps in making the Mount and mounting a Diamond Wire-drawing Die

hole and the die opening, as shown at *D*. The die-holder is next placed on a small brazing stand, and a disk of brass is placed on top of the diamond to prevent the hole in the die from becoming filled with spelter, after which a vertical clamp is fastened down on top of the brass disk. The clamp is made of steel, with a small point bearing down on the brass.

The die-holder is then heated with a gas and air blow-torch until it is red-hot, after which spelter and borax to act as a flux are placed on top of the socket containing the diamond, and the flame is applied to this spelter until it melts and completely fills the space surrounding the diamond. Then the work is allowed to cool, after which the holder is set up on a small jeweler's lathe, locating it from a mandrel through the drilled hole and the opening in the diamond, to bring the circumference of the mount concentric with the hole in the die, after which the holder is machined all over. The work is then chucked from its outside diameter, and the hole which was drilled from one side extending through the diamond die opening is drilled the remainder of the way through the holder. This hole is then bored out at each side, so that a bell-mouthed opening of uniform curvature is produced. This brings the work to the condition shown at *F* in Fig. 3. When the work has been brought to this point, the final steps are to stamp it with the size of the die opening and with the manufacturer's trade name. But no matter how carefully a setting is made, it cannot take the place of a thick wall of diamond. This fact has been proved in plants engaged in drawing tungsten wire, which is the most severe service in which diamond dies are employed.

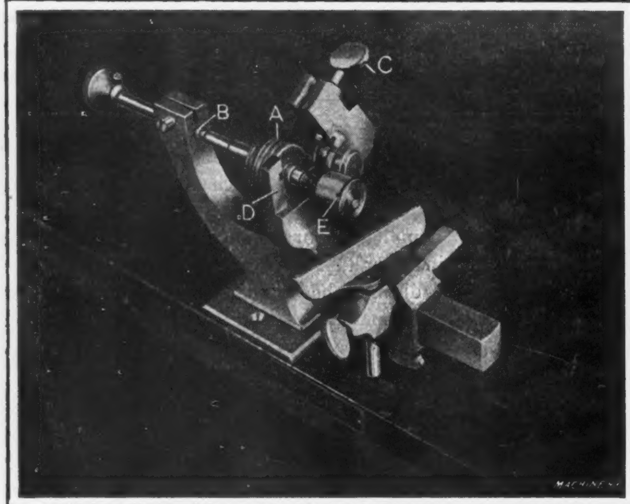


Fig. 4. Special Type of Lathe used for refinishing an Unmounted Diamond Wire-drawing Die

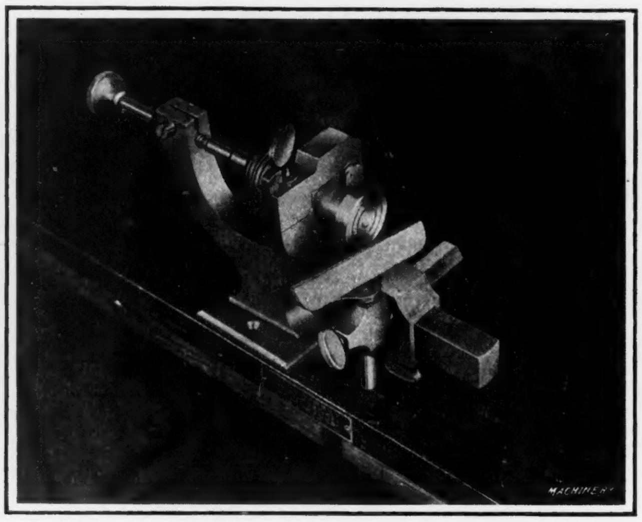


Fig. 5. Special Type of Lathe used for refinishing a Mounted Diamond Wire-drawing Die

Refinishing Diamond Dies

A feature of diamond dies, which makes it possible for them to be used more economically than dies made of steel, cast iron, or some other inexpensive material, is that the extreme hardness of the diamond enables it to give a far greater amount of service before the tool is worn out. This resistance against wear is also the means of maintaining greater uniformity in the diameter of the wire that is drawn through the die. No material is hard enough to be proof against wear, and so the opening in the diamond die finally becomes too large to produce wire that comes within the specified limits of tolerance. When this point has been reached, the die must be recut, which is done by the use of a steel lapping tool charged with diamond dust, which is of similar form to the ones that were used for cutting new dies. The amount by which the diameter is increased will vary according to the size of the die. The smaller the opening, the less the amount by which the diameter will be increased. For medium sized dies, 0.005 inch increase in diameter will be made at each cutting. When the die has been recut, the bell-mouthed opening must again be carefully finished to bring it tangent to the new throat which has been cut in the die, after which the inner surface must once more be carefully polished to make the die fit for subsequent service.

Figs. 4 and 5 show a special type of lathe which is used by the Vianney Wire-Die Works for refinishing diamond dies. There is nothing exceptionally noteworthy about the design except the provision which is made for lifting both the spindle and work out of the head in order to facilitate gaging the diameter of the die opening. It will be seen that a cone pulley *A* is mounted directly on the spindle and that the steps of this pulley are grooved to carry a small cord that serves as a driving belt. At its left-hand end the spindle is centered to receive the point of a center *B*; and at the right-hand end, a journal on the spindle fits into a bearing box. Reference to Fig. 4 will show that the housing in which this bearing is mounted is arranged in such a way that by turning button *C* an eccentric latch enters the slot in locking member *D* and holds the bearing cap down on the spindle. When it is required to remove the spindle and work, this is done by simply turning button *C* and raising the bearing cap.

Lathes of this type are used for finishing diamond dies both before and after they have been mounted. Fig. 4 shows an unmounted stone set up for refinishing, and in Fig. 5 a mounted stone is shown in place on the machine spindle. It is interesting to note that in the diamond die industry, a diamond in which the die opening has been drilled and completely finished is called a "drilled stone" until such time as the stone has been mounted. Then the complete stone and its mounting are known as a "diamond die." At the right-hand end of the spindle there is a cup-shaped opening with a small notch *E* cut in the edge, as shown in Fig. 4. For holding an unmounted stone for refinishing, use is made of a small disk of metal that has a projection on one side, which is of just the right diameter so that it can be pressed into the cup with the thumb and index finger. The diamond to be refinished is secured to the face of this metal disk by means of sealing wax or very thick shellac. A hole is drilled through the center of the disk on which the stone is mounted, so that during the process of refinishing, a wire of known diameter may be drawn through the die as soon as the opening has been enlarged sufficiently to make this possible. The work of enlarging the die opening proceeds very slowly and frequent attempts are made to pass the master wire through the die. Directly this result is accomplished the only remaining work is to polish the die opening. For refinishing mounted dies, as shown in Fig. 5, a similar metal disk is used to enter the cupped end of the lathe spindle. The die is secured to this disk by means of shellac or some other suitable adhesive. When it is desired to remove either a mounted or an unmounted stone from the machine spindle, this is done by entering a pin into the slot *E*, Fig. 4, and then prying the metal disk out of the cup on the spindle.

The processes described, being quite different from the ordinary methods used by the machinist in his everyday work, will doubtless prove interesting to many.

LETTERS ON PRACTICAL SUBJECTS

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INTERSECTION OF TAPERS

The following article shows the deduction of the general formula for finding the point of intersection of two tapers with reference to measured diameters on those tapers. Referring to the diagram,

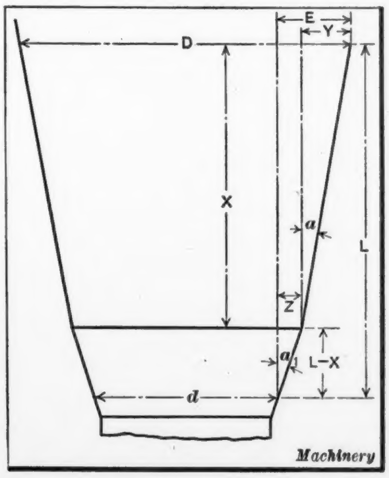


Diagram illustrating Deduction of General Formula for finding Point of Intersection of Tapers

L = the distance between the two measured diameters and d;

X = the required distance from one measured diameter to the intersection of tapers;

a = angle of long taper;

a_1 = angle of short taper.

Then

$$E = \frac{D - d}{2} = Z + Y$$

$$Z = (L - X) \tan a_1$$

$$Y = X \tan a$$

Therefore:

$$\frac{D - d}{2} = (L - X) \tan a_1 + X \tan a$$

and

$$D - d = 2 \tan a_1 (L - X) + 2X \tan a \qquad (1)$$

But

$$2 \tan a_1 = T_1 \text{ and } 2 \tan a = T$$

in which T and T_1 represent the long and short tapers per inch, respectively.

Therefore from Equation (1)

$$D - d = T_1 (L - X) + TX$$

$$D - d = T_1 L - T_1 X + TX$$

$$X (T_1 - T) = T_1 L - (D - d)$$

$$X = \frac{T_1 L - (D - d)}{T_1 - T}$$

Richmond College, Va. V. E. Ayre

EQUIPMENT FOR FINISHING INSIDE OF BOX PATTERNS

The tooling equipment for finishing the inside surfaces of an aluminum pattern is shown in Fig. 2 as it appears when set up, and the tool-carrying spindle which is used in performing the work is shown in detail in Fig. 1. The pattern itself is of box construction, 16 inches long, 10 inches wide, and 9 inches deep, having an offset extending across one entire side, forming a knee inside the pattern about 4 inches high. Thousands of castings were to be made from this pattern, the walls of which were required to be kept within a specified thickness—a fact which warranted the building of the special machining tools. The available material was limited; therefore the equipment was made and attached in the following manner.

A 16-inch shaper was available, and an angle-plate, which had been made for use in planing the regular casting (and therefore which was of sufficient dimensions) was also made use of to clamp the pattern on the shaper. The tool-holding spindle was made from a piece of gas pipe of the required length. This pipe A, Fig. 1, was bored out at each end and a bronze bushing B inserted. The bushing at the pulley end

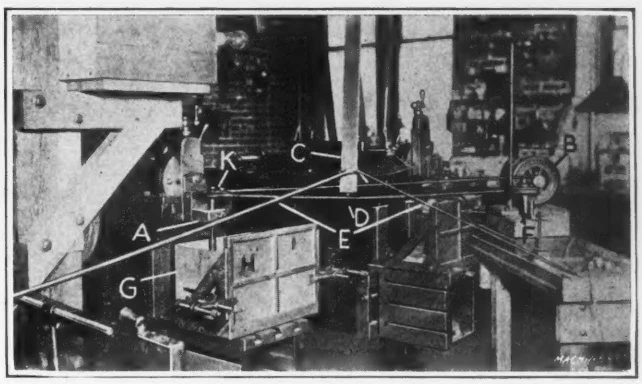


Fig. 2. Set-up, showing Method of employing Shaper to mill the Pattern

was bored out to 5/16 inch in diameter, and the bushing at the cutter end was taper-bored to fit the tapered sleeve E. The cutter-shaft D was made of 5/16-inch drill rod, on one end of which a cold-rolled collar or cutter-holder C was shrunk and pinned at L, after which the hardened steel tapered sleeve E was forced on the shaft, bearing against the cutter-holder. The opposite end of the cutter-shaft was

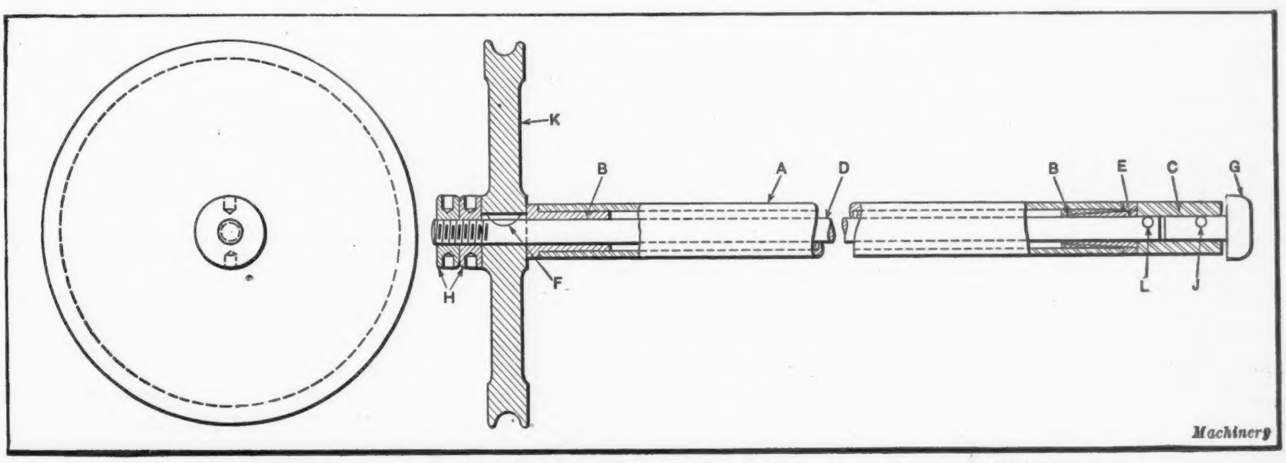


Fig. 1. Improvised Tool-carrying Spindle used in finishing Interior of an Aluminum Pattern

threaded and splined about an inch from the end for a small Woodruff key. The cutter G was then inserted in the holder and secured by means of a tapered pin J, after which the shaft, with holder C, cutter G, and sleeve E assembled, was placed in the gas pipe. The grooved pulley K was next assembled on the shaft by means of the key F, the entire unit being held in place by means of the check-nuts H. A further function of these check-nuts is to hold the tapered sleeve E and the bushing B in contact, the action being similar to that of a draw-in collet chuck. The space between the shaft and the inside of the gas pipe was partly filled with light grease for lubricating purposes. The cutters were hand made, as a milling machine was not available, and were shaped to fit the fillet in the inside of the pattern.

A cast-iron bracket A, Fig. 2, was made to hold the spindle, and was attached to the tool-head of the shaper by means of a special bolt, which was made to fit the toolpost hole. The drive was furnished by running a round belt from a 1/4 horsepower motor B, mounted on an adjacent bench, to the pulley K on the spindle, the power being furnished by the lighting system. The pulley F was used to prevent the belt from slipping off the motor pulley. A pole or "mule" C was hooked to a ceiling joist, so that it could swing, and at its lower end carried a small idler pulley D. The function of this arrangement was to exert a constant pressure on the belt as the distance between the motor and the pulley increased or decreased with the traverse of the cutter-spindle. The pulley D was kept in contact with the belt by means of the tension exerted by weights attached to two pieces of rope E.

With the work G in place, clamped to the angle-plate H, the operation was performed by feeding the platen crosswise, using the shaper cross-feed handle, and by obtaining the forward and backward traverse by throwing the belt off the cone pulley and operating the ram by means of the stroke-setting handle. While the work was not finished in production time, it was a quicker method than scraping and much more accurate. This device has since been used on several similar jobs and has been found a satisfactory and efficient equipment.

St. Louis, Mo. J. W. GERDEL

CHART FOR ESTIMATING TURNING TIME

Charts for finding the time required to perform a turning operation in a lathe may be readily constructed as shown in the accompanying illustration. The vertical lines represent the number of revolutions per minute of the work, as indicated by the notations at the top of the chart; while the horizontal lines indicate the time in minutes required for turning one inch of length. Although this particular chart was designed for use when estimating time consumed in performing work on a Hendey engine lathe, the feeds given in the lower right-hand corner of the chart and the curves corresponding to them may be varied to suit the style and size of the lathe in use. In order to obtain the total time for turning a given length, the time obtained from the chart must be multiplied by the total length of the work, since the chart is based on lengths of one inch.

Such a chart may be arranged for use in connection with thread cutting, provided the number of cuts required and the other conditions entering into the operation of thread cutting are taken into consideration. For instance, it would be necessary to multiply the time obtained from the chart by the number of cuts taken and to include the carriage return time. It will be seen, therefore, that the most dependable use to which such charts may be adapted is for turning rather than for thread cutting, owing to the numerous factors which must be considered when estimating thread cutting time. On rough work, such as bolts, nuts, and similar parts, there are not so many cuts required as, for instance, on the more accurate precision screws and thread gages. No definite rules govern this, however, except as may be decided upon by good shop practice.

In making the chart it will be found convenient to tabulate the spindle speeds for various sizes of lathes, as taken from the specifications of the machine. If a great variety of speeds is used, those charts which include the higher numbers of revolutions per minute should be made to scales which will take care of the corresponding decrease in time, so that the curves will not blend into each other at the lower right-hand corner of the chart. Data of this kind, when arranged in chart form, will be found helpful in the drawing and planning departments, where much estimating is done, which

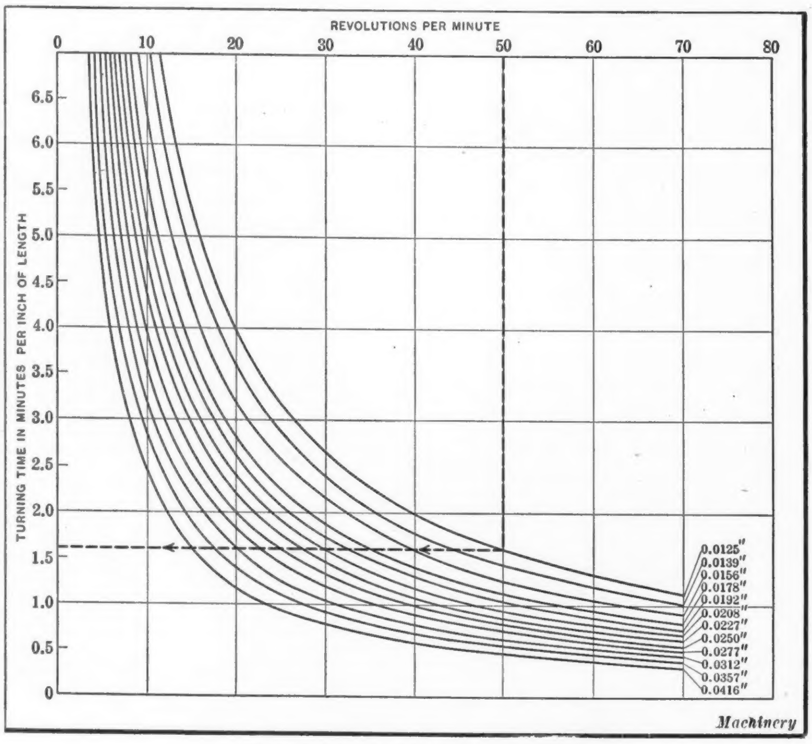


Chart used to obtain Lathe-turning Time

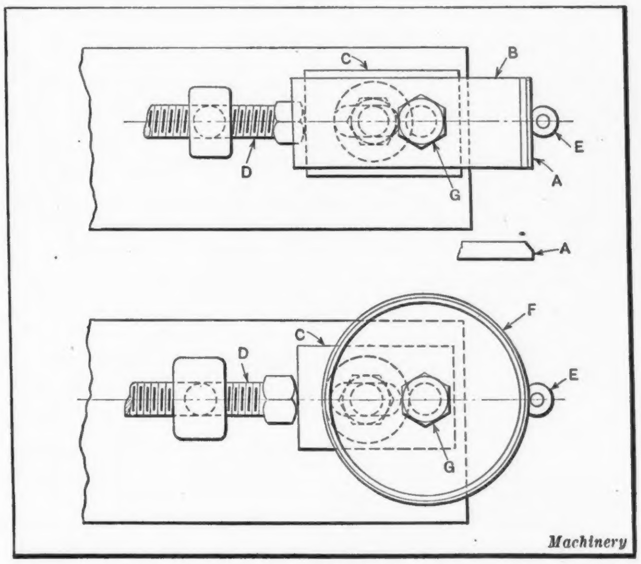
will result in a saving of time that would otherwise be consumed in working out formulas.

No detailed explanation of the use of the chart should be necessary, but the following example shows the direct advantages of such a chart. It is required to take one cut over a steel shaft 10 inches long. If the work revolves at fifty revolutions per minute and if the recommended feed for this speed is 0.0125 inch, the time for cutting one inch of length at this rate may be found by following the curve corresponding to this feed until it intersects the vertical line marked fifty revolutions per minute; then following horizontally to the left-hand margin, the time 1.6 minutes is read off. Multiplying this by 10 inches, the length of the shaft, the total time required is 16 minutes.

Plainfield, N. J. J. B. CONWAY

CIRCULAR BLADE FOR CUTTING OFF WIRE

Standard wire-working machines are usually furnished with a cutting-off arrangement similar to that shown in the upper part of the accompanying illustration. However, the continued use of a flat tool, such as B, will cause the cutting edge A to become dull and worn, requiring frequent regrinding. This results in loss of time and consequently of



Circular Blade attached to Cut-off Slide of a Wire-working Machine

considerable production, since several minutes are required to resharpen the cut-off and to replace it on block *C*. This block must also be reset every time a blade is reground, so that the cutting edge will just pass beyond the hole in the quill *E*. An improvement over this type of cutting-off blade is shown in the lower part of the illustration. Instead of a groove being cut in block *C* to hold the flat cut-off *B*, as in the first design, the block is finished with a flat face. A circular cut-off *F* is then substituted for the flat blade and is held stationary by means of a screw *G*. The block is set by adjusting screw *D* the same as when the flat blade is used.

The advantage of this attachment is that no adjustment and no regrinding are required when the cutting edge is renewed. When the cutting edge becomes dull, the screw *G* is simply loosened, and the circular blade slightly revolved and again clamped in position. A cut-off of this type will wear for several years without having to be removed from the machine. The writer recalls one instance in which such a cutter was used continuously for more than four years without being resharpened.

Baltimore, Md. S. B. Royal

WHY DON'T MORE PEOPLE USE LOGARITHMS?

One is often told that a practical knowledge of trigonometry and logarithms can be obtained only in colleges, but in more than forty years acquaintance with machinists, the writer has known of many men handling these subjects as easily and skillfully as the common tools of their trade, whose knowledge and facility were acquired in that popular and inexpensive institution—the College of the Midnight Lamp. There are, however, many persons, thoroughly familiar with the application of logarithms, who seldom or never employ them in their everyday work, even when considerable time would be saved by their use. The following example shows clearly the advantages gained by employing the logarithmic method of solving a practical problem in trigonometry.

The problem presented in the accompanying illustration is to determine the diameter *D* of a plug, which when laid in the gage, will be exactly flush with its top. The formula for the diameter required is found as follows: First construct the diagram shown at the right, making line *HK* equal to the distance from *A* to *B*, or 0.750 inch; then from point *H* draw line *HG*, making angle *GHK* equal to angle *FBP*. The magnitude of this angle is found by adding 90 degrees to 18 degrees 45 minutes, and subtracting the sum from 180 degrees, which gives 71 degrees 15 minutes. In a similar manner, determine angle *EAC*, which is found to be 76 degrees 30 minutes. Now draw line *KG*, making angle *HKG* equal to 76 degrees 30 minutes. Next draw two lines bisecting angles *GHK* and *GKH*, respectively, and through *L*, the point of intersection of the two bisecting lines, draw *LM* perpendicular to *HK*. It is evident that *LM* will be the radius of an inscribed circle and therefore will equal one-half the required diameter *D*. In triangle *HLK*, we have three known elements: Angle *LHK* equals 35 degrees 37 minutes 30 seconds, or one-half *GHK*; angle *LKH* equals 38 degrees 15 minutes; and angle *HLK* equals 106 degrees 7 minutes 30 seconds (180 degrees—35 degrees 37 minutes 30 seconds—38 degrees 15 minutes). Now in the oblique triangle *HLK*,

$$HL = \frac{0.750 \times \sin 38 \text{ degrees } 15 \text{ minutes}}{\sin 106 \text{ degrees } 7 \text{ minutes } 30 \text{ seconds}}$$

Then in triangle *HLM*, side *LM* equals side *HL* × sin 35 degrees 37 minutes 30 seconds. From these two equations it is evident that

$$LM = \frac{0.750 \sin 38 \text{ deg. } 15 \text{ min.}}{\sin 106 \text{ deg. } 7 \text{ min. } 30 \text{ sec.}} \times \sin 35 \text{ deg. } 37 \text{ min. } 30 \text{ sec.}$$

and as *LM* equals one-half the required diameter,

$$D = 2 \times \frac{0.750 \sin 38 \text{ deg. } 15 \text{ min.} \sin 35 \text{ deg. } 37 \text{ min. } 30 \text{ sec.}}{\sin 106 \text{ deg. } 7 \text{ min. } 30 \text{ sec.}}$$

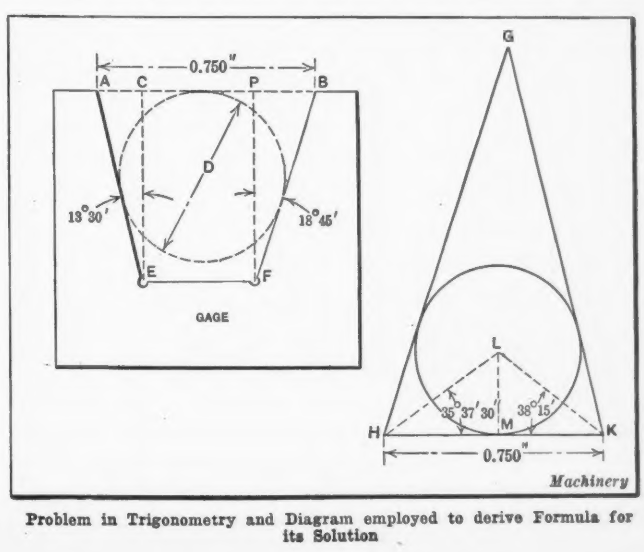
from which

$$D = \frac{1.5 \times 0.61909 \times 0.58248}{0.96066} = 0.563062 \text{ inch}$$

Thus to make the necessary calculations by natural numbers using five-place functions, calls for three multiplications and one division, requiring the use of more than a hundred figures. To solve the same problem using six-place logarithms, necessitates the making of only thirty-five figures not including the answer, thus:

Log 1.5	0.176091
Log sin 38 deg. 15 min.	9.791757
Log sin 35 deg. 37 min. 30 sec.	9.765279
Colog sin 106 deg. 7 min. 30 sec.	0.017431
Log diameter	9.750558
Diameter	0.563064 inch

From this example it will be clearly seen that the logarithmic method is not only simpler and easier than the arithmetical method, but also that more accurate results may be obtained. A still more striking example of the value of the logarithmic method is presented by a problem recently brought to the writer's attention, in which it was necessary to calculate the diameters of steel balls to weigh, respectively, 9/16, 7/16, 3/8, and 5/16 as much as a sample ball 1.3625 inches in diameter. Instead of extracting the cube root of each of these fractions and multiplying 1.3625 by the several roots, the simpler method of dividing the logarithm of each



Problem in Trigonometry and Diagram employed to derive Formula for its Solution

fraction by three and adding each quotient to the logarithm of 1.3625 was used, thus obtaining the required logarithm for each diameter.

New London, N. H. GUY H. GARDNER

REMOVING RUST FROM TOOLS

Tools which have become very rusty should be treated with a chemical solution, instead of trying to scour the rust off by means of emery cloth. A good solution for removing rust may be made as follows: Into one quart of distilled water dissolve, little by little, sufficient chloride of tin to obtain a saturated solution, that is, until the water will not dissolve any more of the salts. Put the tool into a receptacle containing the solution and let it stand over night. In the morning rinse the solution off in running water and dry thoroughly with a piece of chamois or cloth.

Youngstown, Ohio W. S. STANDIFORD

PUNCH PRESS OPERATIONS ON T-IRON BARS

In the July number of MACHINERY, page 1068, there appeared an article describing several punches and dies used

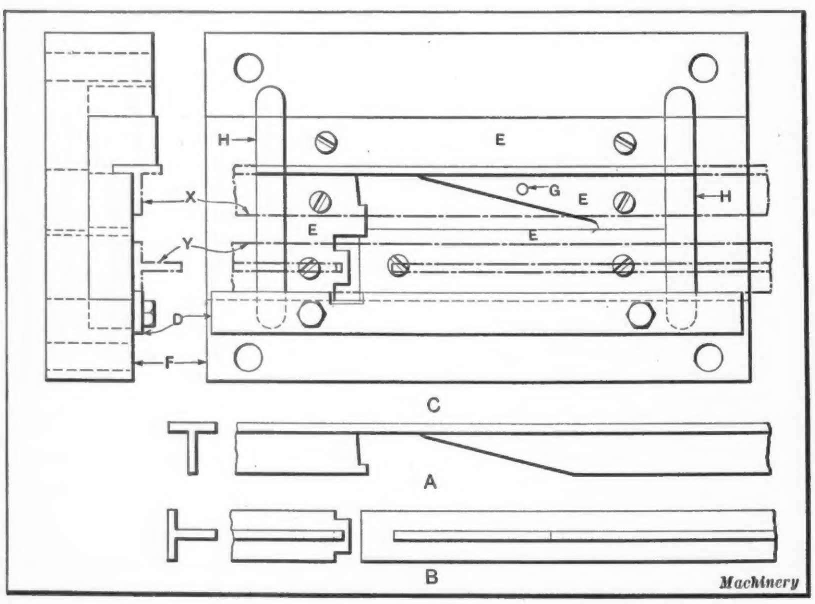


Fig. 1. Die for cutting T-iron Bars as shown at A and B

in cutting operations on T-iron bars. Another punch and die which has performed similar operations satisfactorily is presented in this article. In this case, two operations are performed on one machine. The first consists of cutting out the web of the T-iron bar as shown at *A* in Fig. 1, the flange of the bar being cut off as shown at *B* by the second operation. The die *C* is employed in performing these operations. The dot-and-dash lines *X* indicate the position of the T-iron bar during the first operation. After this operation has been performed, the bar is turned and placed with one edge of the flange against the flat bar *D* as shown by the dot-and-dash lines *Y*, while the end of the T-iron bar is located against a stop in order to gage the length of the piece to be cut off. This stop is not illustrated. The bar is then properly located for performing the second operation. The tool-steel dies *E* are hardened and ground, and are secured to the cast-iron die-bed *F* by means of fillister-head screws and the dowel-pin *G*. The tool-steel pieces *H* relieve these screws and dowel-pin from end thrusts during the cutting opera-

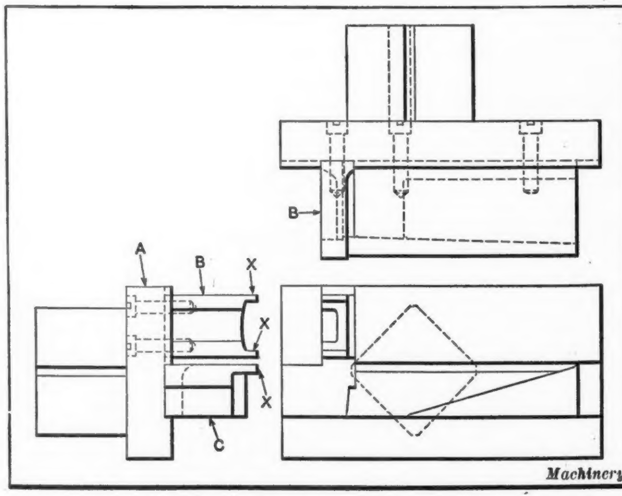


Fig. 2. Cutting Tools used in Connection with Die shown in Fig. 1

tions. The die-bed has four holes to afford means for bolting to the press bolster. The T-iron bars are held in such a manner that they cannot move during the operations, and cuts without burrs are produced.

The punches and punch-holder employed in connection with this die are illustrated in Fig. 2. The cut-off punch *B* and the web-cutting punch *C* are held in slots in the holder *A* by means of fillister-head screws. The ends *X* of the cutting tools enter the die as the press ram descends and serve as guides during the cutting operations, thus preventing the tools from moving, while holder *A* has a square shank which prevents the holder from turning.

Fig. 3 shows a die which could have been used for performing the first two operations upon the T-iron bar in the article previously referred to. The construction of this die is similar to the one just described. As in that die, the bar is placed in the position indicated by the dot-and-dash lines *X* for the first operation. This operation leaves a portion *B* of the flange between the angular cuts on the web of the bar, which can be clearly seen in the detail of the bar shown at *A*. This metal is sheared out by a second operation after the bar has been placed in the position indicated by the dot-and-dash lines *Y*. By the use of this die, rapid production is obtained, as a finished piece is produced with every two strokes of the punch, and the cost of tools is reduced because both operations are performed on one machine.

New Britain, Conn. JOHN CLARKSON

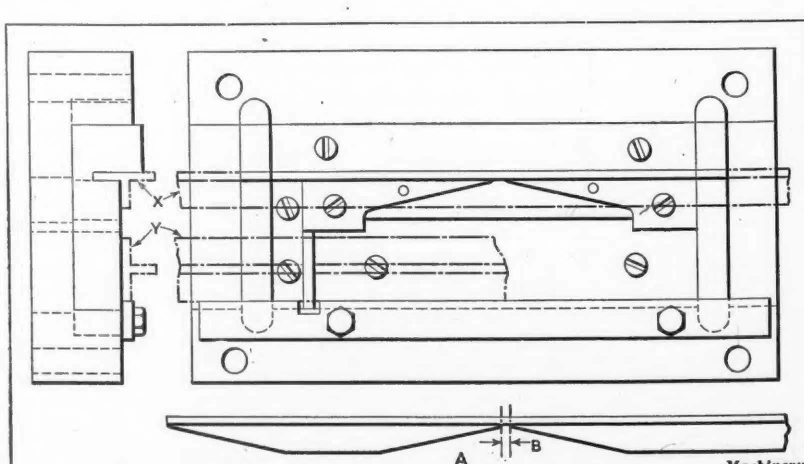


Fig. 3. Die for performing Another Operation on T-iron Bars

RAPID CALCULATION OF PIECE-WORK EARNINGS

A punch-card like that shown in Fig. 1 is used by men in a certain shop who are working by the piece work system. The workmen fill out the headings on the cards, after which the correct number of accepted pieces is punched in the card either by the foreman or by the inspector. A column is provided on the card to indicate the quantity of rejected pieces, and is used for the purpose of finding the costs of spoiled and defective pieces. If the number of finished pieces is greater than can be taken care of on one card, the surplus is punched on another card, and both are then attached to the time card for the day. In order that the card may be properly classified in the payroll department, it will be noted that the rate per piece is indicated at the bottom of the card.

A number of rate blocks such as shown in Fig. 2 are kept in racks, which are so situated as to be easily available for the payroll clerk. There should be a sufficient quantity of these blocks to cover all rates in active use in the shop, that is, one block for each different rate per piece, and each block carrying the rate marked on it. These rate blocks are simply pieces of hard wood over which transparent celluloid is stretched and fastened by means of brass strips and screws.


1018-76364

MAN John Doe NO. 420

OPERATION 491- 3rd DATE 5-27-19.

										REJ.
1	26	51	76	101	126	151	176	201	226	1
2	27	52	77	102	127	152	177	202	227	2
3	28	53	78	103	128	153	178	203	228	3
4	29	54	79	104	129	154	179	204	229	4
5	30	55	80	105	130	155	180	205	230	5
6	31	56	81	106	131	156	181	206	231	6
7	32	57	82	107	132	157	182	207	232	7
8	33	58	83	108	133	158	183	208	233	8
9	34	59	84	109	134	159	184	209	234	9
10	35	60	85	110	135	160	185	210	235	10
11	36	61	86	111	136	161	186	211	236	11
12	37	62	87	112	137	162	187	212	237	12
13	38	63	88	113	138	163	188	213	238	13
14	39	64	89	114	139	164	189	214	239	14
15	40	65	90	115	140	165	190	215	240	15
16	41	66	91	116	141	166	191	216	241	16
17	42	67	92	117	142	167	192	217	242	17
18	43	68	93	118	143	168	193	218	243	18
19	44	69	94	119	144	169	194	219	244	19
20	45	70	95	120	145	170	195	220	245	20
21	46	71	96	121	146	171	196	221	246	21
22	47	72	97	122	147	172	197	222	247	22
23	48	73	98	123	148	173	198	223	248	23
24	49	74	99	124	149	174	199	224	249	24
25	50	75	100	125	150	175	200	225	250	25

RATE-0.02

Fig. 1. Punch-card used in calculating Earnings of Piece-workers

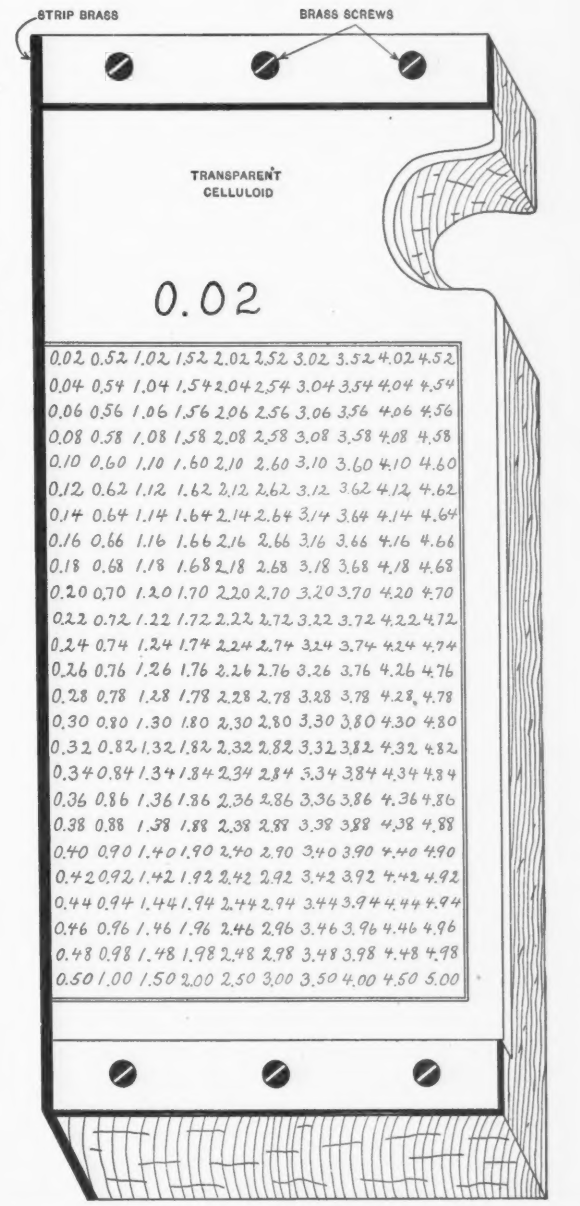


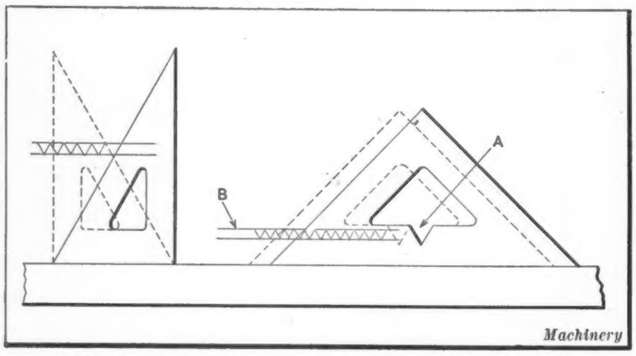
Fig. 2. Rate Block used in Connection with Punch-card shown in Fig. 1 for determining Amount a Workman earns at a Certain Rate on a Piece-work Basis

The amount a man would earn under a certain rate, from 1 to 250 pieces, is marked in ink on the celluloid sheet of the block corresponding to that rate, and in exactly the same position as the numbers appear on the punch-card. When the clerk inserts the punch-card under the celluloid on the rate block, the amount due the workman appears directly over the punch mark on the punch card. Although the block shown in the illustration is used for the easily computed rate of 2 cents, it will be seen that for rates such as $0.062, the possibility of an error occurring in computing the piece-work earnings is quite great. This simple scheme has proved valuable as a time-saver, and has practically eliminated mistakes in the payroll department.

Bellows Falls, Vt. S. P. KEATOR

KINK FOR DRAWING SCREW THREADS

When laying out a standard V-thread, it is customary to use a 60-degree triangle in the manner shown at the left in the accompanying illustration. In order to save time and simplify the operation, a small 60-degree angle *A* may be cut in the central opening of a triangle as shown at the right in the illustration, using an ordinary knife or file for the purpose. In constructing a screw thread, lay out two lines *B* to represent the depth of the thread and place the triangle on the T-square so that the 60-degree notch lies di-



Triangle with V-notch for Use in drawing Screw Threads

rectly over the two construction lines, then simply shift the triangle to the right and left alternately as required, using the sides of the notch as a ruling edge in drawing the thread. Similar notches may be cut in opposite positions on the triangle; the angle on drill ends, flat-head screws, etc., may then be represented in the same manner as previously described. Although a 45-degree triangle is used in the illustration, it is evident that any triangle may be employed equally as well. This method will prove a great convenience as well as a time-saver to the draftsman.

Toledo, Ohio R. C. Eastin

KEEPING THE SLIDE-RULE IN GOOD CONDITION

The writer has found the following treatment to be a simple means of keeping a slide-rule in good working order. Clean thoroughly with kerosene and, after drying, sprinkle the contact surfaces of the slide with talcum powder. While applying the powder, work the slide in and out of the rule in order to spread the powder. This treatment will produce a smooth sliding action and render the rule less susceptible to the influence of varying climatic conditions which affect the degree of frictional resistance of the slide.

Philadelphia, Pa. Thomas P. Laycock, Jr.

AREA OF A SEGMENT

The area of a segment may be found by employing the following formula, which is somewhat different from that given in Machinery's Handbook, page 132, and is much simpler in form, and therefore more convenient to use.

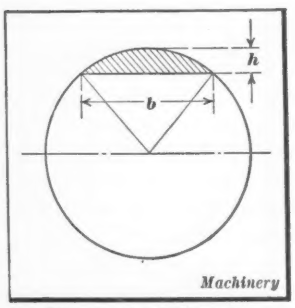


Diagram for finding Area of a Segment

Referring to the diagram:

$$A = \frac{h^3}{2b} + 0.6604\,hb$$

in which

h = height of the segment;
b = length;
A = area.

R. L. Friess
Bowling Green, Ohio

FIXTURE FOR CENTERING ECCENTRIC WORK

The fixture shown in Fig. 1 is for use on milling machines when centering work which has more than one center, such as a crankshaft. The device consists of a circular base A having two ears by means of which it is strapped to the machine table. There is a central plug B about which the V-block casting C may pivot, and a circular T-slot in which the heads of the clamping bolts travel when the position of the top part of the fixture is changed. The V-block casting holds the work while it is being centered, and carries a locating plug D which engages one of the four bushed holes, equally spaced in the base, so that the work may be indexed at every 90-degree turn of the fixture.

In use, after the fixture has been attached to the table of the machine, the work is clamped in the V-block with an equal overhang on each side, and with the center line of the wrist coincident with that of the machine spindle and directly above the center line of the shaft, as shown in Fig. 2. After the first center has been made, the table is raised an amount equal to the throw of the crank, using the machine dial to accurately locate the second center. To center the work at the opposite end, it is only necessary to loosen the clamping bolts in the base, remove the plug D, index the

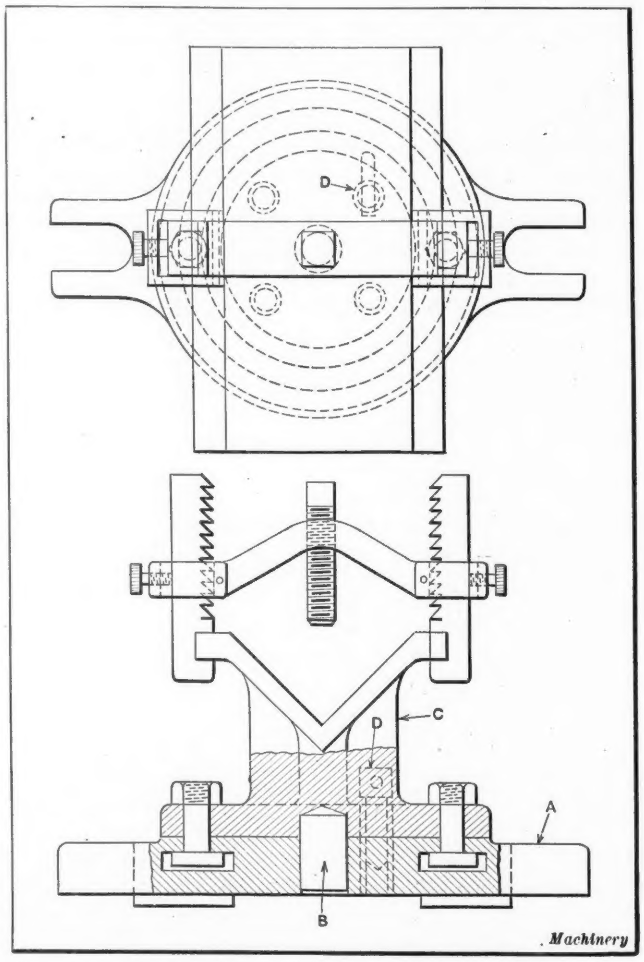


Fig. 1. Centering Fixture for holding Crankshafts and Similar Parts when centering

work-holding block 180 degrees, replace the plug and repeat the centering operation, but, of course, in this case, in the reverse order.

Many uses may be made of a holding fixture of this type. It will be found useful when centering special arbors such as used when machining cams and similar parts having a number of centers, and it may also be employed for clamping parts of various shapes when performing light operations

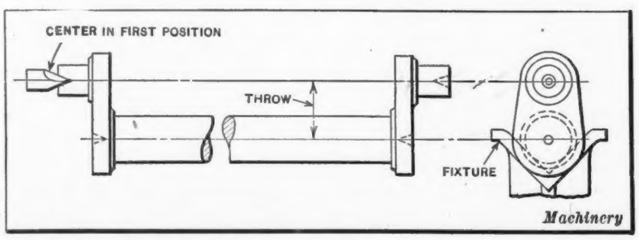


Fig. 2. Sample of Work centered in the Fixture shown in Fig. 1

on the ends of the work. Accuracy and a saving of time are two valuable advantages derived from the use of a fixture of this type.

Beverly, Mass. John T. Clark

HOW AND WHY

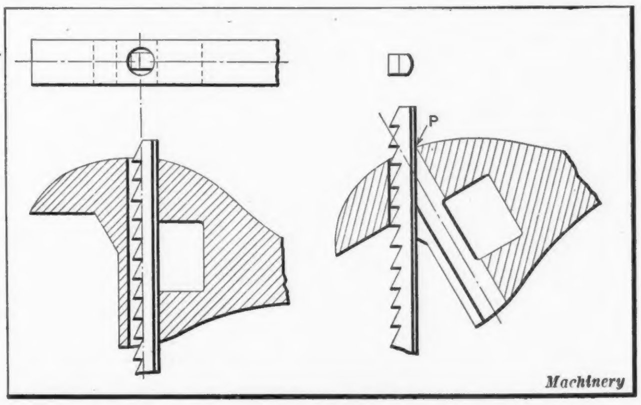
QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

PRODUCTION PROBLEM FOR THE MACHINE SHOP

M. M. S.—What is the best method to employ, on a production basis, in removing stock from a wrench head in which the movable jaw of the wrench operates, as shown in the illustration on page 1086 in the July number of MACHINERY? The stock removed forms a slot which cuts into the previously drilled hole for the jaw rack.

ANSWERED BY CHARLES D. FOLSOM, JR., WHITESTONE, N. Y.

Several suggestions for the solution of this problem appeared in the August number of MACHINERY, but only one method was suggested by which it would be possible to perform the work as per specifications in a single operation. However, the job might also be performed in one operation on a keyseater. A broach-like cutter such as shown in the accompanying illustration should be used, although a standard keyway cutter might be adapted to the requirements of the job by rounding the back edge to the radius of the hole so as to obtain greater rigidity. A fixture would be required which should be designed after the same general principle as that illustrated in the August number, page 1182. The view at the left in the accompanying illustration shows the position of the cutter and work at the beginning of the operation, while at the right the position of the work is shown



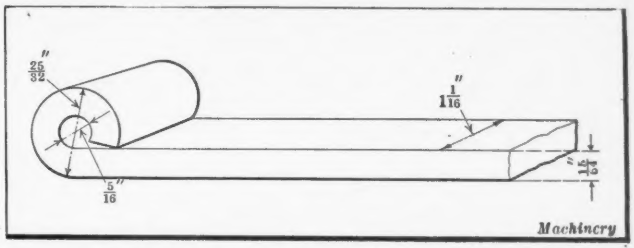
Relative Position of Cutter and Work before and after Performance of Operation

at the completion of the operation. While the cutter is reciprocating, the work should be swung around on the fixture with point P as an axis. A support for the cutter would be required and should be located immediately above the work in such a way as to be unaffected by the swing of the work around axis P. On account of the slenderness of the cutter, the latter provision should not be overlooked. A relieving device should also be incorporated in the support for the cutter, so as to operate on the upward stroke of the machine.

It would not be practicable to take heavy cuts with such a slender cutter. However, with a suitable holding fixture, the job could be put upon a production basis, using a simple inexpensive machine, which could be operated by unskilled help, and at the same time would maintain a rate of production which, in the opinion of the writer, would be somewhat higher than by any other method so far proposed.

PRODUCTION PROBLEM FOR THE FORGE SHOP

H. C. T.—The end of a steel bar must be rolled to the shape shown in the accompanying illustration. These pieces are in lengths of 150 millimeters (about 5 29/32 inches) and 200 millimeters (about 7 7/8 inches). The size of the stock is 27 millimeters wide (1 1/16 inches) and 6 millimeters thick (about



Bar with Rolled End for the Manufacture of which Suitable Dies and Information are required

15/64 inch); the diameter of the rolled end is 20 millimeters (about 25/32 inch), and the diameter of the eye is 8 millimeters (about 5/16 inch). These ends have previously been hand-forged, but it is desired to increase production and decrease manufacturing expense by equipping a power press with a suitable die. The table of the power press upon which it is desired to perform this operation is 500 millimeters long (about 19 11/16 inches) and 480 millimeters wide (about 18 29/32 inches); the length of the die-holder is 350 millimeters (about 13 25/32 inches); and the space between the table and the die-holder is 490 millimeters (about 19 9/32 inches). This production problem is submitted to the readers of MACHINERY with the hope that some valuable suggestion may be offered as to the construction of suitable dies to use and advice as to whether or not this job could be performed cold.

A GEOMETRICAL PROBLEM

H. H. B.—A problem quite often encountered in lay-out work is illustrated in the accompanying diagram. It is required to find the values of x and y, these lengths being measured from the intersection of the perpendicular h with the base c. The three sides of the triangle are the only known values. Formulas for obtaining these values are desired, which do not involve numerous or long arithmetical computations.

ANSWERED BY ELMER LATSHAW, WEST PHILADELPHIA, PA.

The method that might first suggest itself is to find the angle A (or B) by some such formula as

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc} \qquad (1)$$

and then solve the right triangle for y by the formula

$$y = b \cos A \qquad (2)$$

Formulas (1) and (2) can be combined as follows

$$y = \frac{b^2 + c^2 - a^2}{2c} \qquad (3)$$

The value of x can be determined in a similar manner.

The solution of a formula of this type is simple enough when a, b, and c are values having but two or three digits,

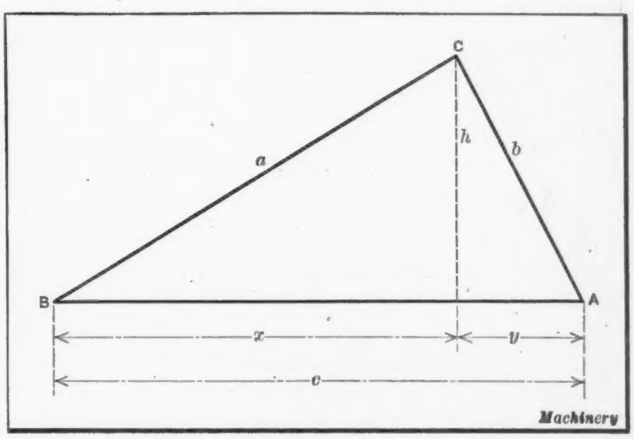


Diagram illustrating the simple Solution of a Geometrical Problem

or if they are simple integers, but if they contain four or five figures each, the work becomes laborious and mistakes are likely to occur when squaring these numbers.

Simpler formulas, as far as the numerical calculations are concerned, may be deduced as follows:

$$a^2 - x^2 = h^2 = b^2 - y^2$$

Transposing and factoring the above equation

$$(x - y)\ (x + y) = (a - b)\ (a + b)$$

from which

$$x - y = \frac{(a - b)\ (a + b)}{x + y}$$

Since $x + y = c$, if we let $x - y = K$, this equation may be expressed thus:

$$K = \frac{(a - b)\ (a + b)}{c} \qquad (4)$$

But

$$x = \frac{(x + y) + (x - y)}{2}$$

and

$$y = \frac{(x + y) - (x - y)}{2}$$

Then substituting for $(x + y)$ and $(x - y)$

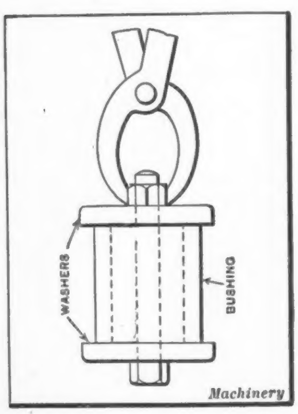
$$x = \frac{c + K}{2} \qquad (5)$$

$$y = \frac{c - K}{2} \qquad (6)$$

Now by examining Formula (4) it may be seen that only one multiplication and one division need be made, the other calculations consisting of simple addition and subtraction. This is a condition that will greatly reduce the liability of mistakes when solving the problem. The actual work required when solving by this method involves simply the solution of Equation (4), from which the value of K is substituted in Equations (5) and (6) when solving for x and y.

TO REDUCE A BUSHING THAT HAS BEEN MADE OVER SIZE

R. V. L.—If a jig bushing, say 3/4-inch inside diameter, has been made a few thousandths inch over size, how could it be heat-treated and rehardened so as to reduce it to size or a few thousandths inch under size?



ANSWERED BY M. JACKER SAN FRANCISCO, CAL.

This bushing could be reduced in size by the following method: Bolt an iron or steel washer securely against each end of the bushing as shown in the illustration; then heat slowly to a cherry red, and plunge into a cooling bath; this will reduce the size.

FORMING DEEP CORRUGATIONS

H. A. A.—Corrugated parts similar to the one illustrated in the June number of MACHINERY, page 978, are required in large quantities. How can they be produced? Copper having a thickness of about 1/64 inch is to be used.

ANSWERED BY JOHN J. POLE, GENEVA, N. Y.

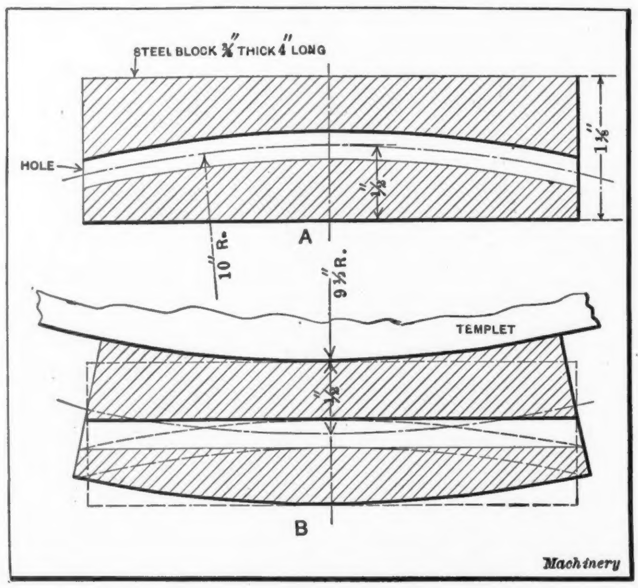
Referring to the manufacturing problem which was submitted in the June number of MACHINERY and answered in the August number, it is the writer's opinion that the method outlined for performing the operation would be rather expensive, and the following suggestion is offered in its place: Form the piece between two sets of rollers of such diameters that the inside set may pass through the piece when the work is completed. Provision would have to be made to space the rollers properly and to close them up as the work progressed. One set of rollers could be mounted on the lathe spindle and the other set fed up, the work being between the two sets of rollers. The inside set of rollers would drive the work if the outside set were fed up carefully.

A MACHINIST'S PROBLEM

L. M.—How can the hole shown at A in the accompanying illustration be machined? The hole is approximately 1/4 inch in diameter and the curvature of its longitudinal center line must conform to that of an arc having a 10-inch radius.

ANSWERED BY AUGUST LEJEUNE, AMBRIDGE, PA.

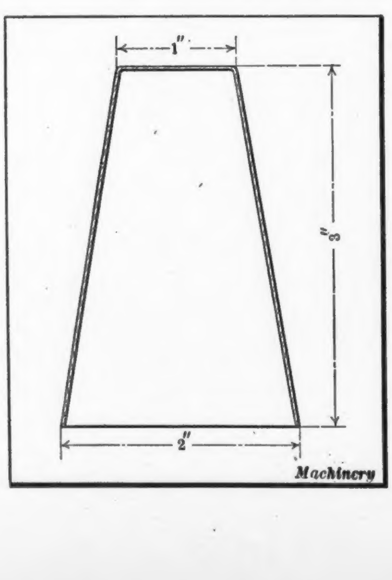
First make a templet the contour of which is determined by an arc having a radius equal to the difference between



Method of producing a Curved Hole in a Steel Block

10 inches and 1/2 inch (the required distance from the center line to the edge of the stock), or 9 1/2 inches. Then bend the steel block to fit the templet, as shown at B. The hole can now be drilled straight through the block as indicated. The dimensions given in the illustration at B show the proper location of the hole. Upon straightening out the stock, the hole will have the required curvature as indicated by the dotted lines.

SHELL DRAWING OPERATION



O. J. L.—A shell of the dimensions shown in the accompanying illustration is to be drawn from No. 26 gage aluminum. It would no doubt be of general interest to the readers of MACHINERY if anyone who has performed drawing operations on the power press on shells of this or similar shape and size can furnish illustrations and a description of the dies which have actually been used in performing such work.

National Machine Tool Builders' Convention

THE annual convention of the National Machine Tool Builders' Association, held at the Hotel Astor, New York City, Wednesday and Thursday, October 15 and 16, was probably attended by a larger number of machine tool builders than any previous convention. Addresses were made by President Newton; William R. Basset (Miller, Franklin, Basset Co., New York City); Bainbridge Colby, New York City; George B. Mallon, Bankers' Trust Co., New York City; and by Alexander Luchars, publisher of MACHINERY. President Newton referred briefly to the great value of the machine tool industry and what it has accomplished. The importance of increased production as an essential factor in solving present difficulties was emphasized, and also in this connection the necessity of new and faster producing tool equipment as a means of compensating for high wages and inadequate labor supply.

Mr. Basset's address was on "Uniform Cost Accounting," and was confined principally to fundamental points rather than to the details of cost-finding methods. Stress was laid upon the necessity of including in costs every item of expense. It was pointed out that there are some items which the average manufacturer almost invariably overlooks. In machine tool building, as an example, there is the matter of spoiling work in process of manufacture. The common practice is to determine costs of parts by obtaining the operation costs for labor and overhead, but neglecting the cost of spoiled parts. This element of spoilage is mentioned as one of possibly several hundred items which the average machine tool builder may not consider when devising a cost system. The question of profit-sharing, which has been discussed considerably within recent years, was also considered by Mr. Basset, who emphasized the point that any sharing of the profits should be done in such a way that it becomes a direct incentive and traceable to the work done by each employe. Incidentally, labor bonuses frequently are not included in the costs. Mr. Basset also referred to the necessity at the present time of so handling the cost accounting problem that sufficient provision be made to pay the heavy federal taxes, which cannot be included in costs. Another important point regarding uniform cost was that manufacturers who do not know about their costs are to be feared, since this represents unintelligent competition.

Mr. Colby's topic was "World Relations and Markets." One of the vital points referred to was the utter lack of men in the United States who are competent to deal properly with foreign trade problems. While the advantages of foreign trade and of locating the world's financial control in this country are appreciated, we do not understand clearly the processes and methods by which the desired results may be obtained. "America," said Mr. Colby, "is by no means out of the van in many important commercial and financial fields, but we are not proficient. For instance, we are far behind European nations in a knowledge of the principles and fundamentals of international banking. Throughout the period of the war, London, despite reeling blows dealt British credit and the enormous strains of financing great war loans, was able to maintain a discount rate somewhat less than one-half the prevailing rate in New York. This was done by understanding the subject of credit. The American banker thinks after he has loaned 80 per cent of his cash resources that he has done all that can be expected. The boundary of his usefulness is determined by the amount of money in the bank over and above legal reserve. That is not the view of the British banker, who does not rate a depositor according to the amount of his balance, but upon his value in the legitimate utilization of the bank's resources and credit. The British banker will float some great loan without touching his cash resources, simply because he has marshalled the credit, whereas the American institution would practically have to pledge its cash resources and then sell the securities." Mr. Colby also referred to the value of a thorough knowledge of foreign languages, and other points closely related to foreign trade development.

The address by Mr. Mallon was on "International Finance," but the labor question and causes of social unrest were also discussed. In dealing with the subject of finance, attention was called to the fact that our rates of exchange are now against all the European countries that offer us the best markets; that such a condition tends to limit our exports to absolute necessities and that Europe needs long-term credits, and it is vitally important that America furnish them, in order to develop export business. Reference was made to the widespread realization of the necessity for a broad market for foreign securities in this country to facilitate export trade, and that such securities must be made not only safe to command public confidence, but also attractive to the investor. Mr. Mallon also referred to the demand at the present time for a type of corporation that is able to finance any kind of export business so that the American producer and the European consumer may sell and buy at once. This would be a stock company and in effect a banking corporation doing a foreign exchange business on long-time credits. Some such plan is being considered and it seems probable that something of this kind will be devised.

Alexander Luchars, who had recently returned from Europe, where he had investigated machine tool conditions as Trade Commissioner of the Department of Commerce, spoke on his experiences in Europe and about the conditions that prevailed in the machine tool trade there, summarizing the information given in his reports.

On Thursday morning, the session was devoted exclusively to committee meetings, and the Thursday afternoon session, to election of officers, etc. The officers for the past year were all re-elected, and are as follows: A. E. Newton, Reed-Prentice Co., Worcester, Mass., president; A. H. Teuchter, Cincinnati Bickford Tool Co., Cincinnati, Ohio, first vice-president; E. J. Kearney, Kearney & Trecker Co., Milwaukee, Wis., second vice-president; C. Wood Walters, Cincinnati Milling Machine Co., Cincinnati, Ohio, secretary; Winslow Blanchard, Blanchard Machine Co., Cambridge, Mass., treasurer; and C. E. Hildreth, Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., general manager.

* * *

The Westinghouse Electric & Mfg. Co. is erecting at its East Pittsburg plant a restaurant seating about 3,500 people. The building is of three-story brick construction, located adjacent to the two main shop entrances. The first two floors will have cafeteria service and will seat 2,500 people. The third floor has a table service restaurant and seats over 1,000 people. This floor can also be used for meetings of various organizations and committees. Interesting mechanical features are being developed in connection with this restaurant. The cafeteria counters have moving conveyor belts which carry the trays of food placed upon them, and several other features which combine engineering with restaurant service have been introduced.

American Gear Manufacturers' Convention

First Steps in Important Standardization Work

THE American Gear Manufacturers' Association held its semi-annual convention at the Copley-Plaza Hotel, Boston, Mass., October 13 to 16, at which meeting a number of important matters, particularly with regard to the society's work in the standardization of gearing, were taken up. At the opening meeting the president of the association, F. W. Sinram, of Cleveland, Ohio, made a brief address relating mainly to the progress of the association. The members were then welcomed to Boston by Frank Burgess, of the Boston Gear Works, who spoke on behalf of the New England gear manufacturers. Various reports were then read by which it was shown that the society is growing in every direction, being now composed of sixty-nine member companies.

At the meetings during the following days papers were read on "Hindley Worms Gears," by H. Fleckenstein, of the Hindley Gear Co., Philadelphia, Pa.; "Uniform Cost Accounting," by A. A. Alles, Jr., of the Fawcus Machine Co., Pittsburg, Pa.; "System and Organization as They Fit Commercial Activities," by S. L. Nicholson, of the Westinghouse Electric & Mfg. Co., Pittsburg, Pa.; "The Individual and Associations," by H. D. Sayre, secretary of the National Metal Trades Association, Chicago, Ill.; "The Labor Problem," by Rodger W. Babson, Wellesley Hills, Mass.; and "Herringbone Gears," by A. F. Cooke, of the Fawcus Machine Co., Pittsburg, Pa.

Standardization Activities

Several of the sessions were devoted to the question of standardization, and the recommended practice for composition gearing, as proposed at the third annual meeting held at Cleveland last spring and now prepared and proposed for adoption as a definite standard of design, was accepted with slight changes. Another report prepared on gears and pinions for electric railway service was accepted as recommended practice. The subject of bevel gearing was also dealt with, and part of the report prepared and proposed by the committee having this matter in hand was accepted as recommended practice. Finally, there was also submitted by the special committee on limits for holes a recommended practice for holes, which was accepted. All of these standards of design or recommended practices will be published in coming numbers of MACHINERY.

The society appears to have definitely begun its work on standardization, and to have accomplished a great deal in the comparatively short time during which this work has been in progress. The standards and the recommended practice accepted by the association will be submitted to the American Engineering Standards Committee with the idea that the standards adopted for gearing may reach a much broader usefulness and be accepted as standards of practice in a much more extended field than that covered by the association itself.

Standardization Methods of the American Gear Manufacturers' Association

The methods in standardizing designs, adopted by the American Gear Manufacturers' Association, classify proposed practice in three different ways as follows: (1) as adopted standards; (2) as recommended practice; and (3) as suggested standards for future design.

Adopted Standards—Any rule, definition, practice, or basis of test adopted by the American Gear Manufacturers' Association as a definite standard shall be known as an "adopted standard." Adopted standards shall be adopted only upon unanimous vote of the members present at a general meeting, following four weeks' notice. An adopted standard may only be rescinded or amended following four weeks' notice, by a two-thirds vote of the entire membership, or upon unanimous vote of the members present at a general meeting. Gears made in compliance with the adopted standards of the American Gear Manufacturers' Association may bear a distinguishing mark to that effect.

Recommended Practice—Any suggestion or practice with reference to which it is impracticable to require rigid acceptance by each member of the American Gear Manufacturers' Association, but with reference to which it is desirable to recommend uniform practice, shall be approved and known as "recommended practice." Recommended practice shall be adopted only upon two-thirds vote of the members present at a general meeting, following four weeks' advance notice. The notice shall state specifically that the rule is being submitted as "recommended practice." Suggestions of recommended practice may be rescinded or amended by a majority vote of those present at any general meeting, following four weeks' advance notice.

Suggested Standards for Future Design—Any rule or standard which cannot be approved either as an adopted standard or as recommended practice, but is merely recommended for future designs, shall be adopted and known as "suggested standard for future design." The same vote is required for suggested standards for future design as specified for recommended practice. Suggested standards for future design can be rescinded or amended by majority vote of those present at any general meeting, following four weeks' advance notice.

Abstract of Paper on Hindley Worm-gearing

In his paper on Hindley worm-gearing, Mr. Fleckenstein mentioned that the first machine designed for the commercial production of Hindley worm-gears was built about 1878, when Stephen A. Morse became interested in a patent on a machine for cutting Hindley worm-gears. He obtained the right to build one of these machines, and proceeded to have one made. After the usual complications met with in building a new type of machine, he finally developed a successful machine, about 1880, and at that time cut Hindley worm-gears on this machine. Later several machines were built and all worm-geared elevators manufactured by Morse, Williams & Co., were equipped with Hindley worm-gears, and much of the success of these elevators was due to the type of gearing used, which had an unusually long life. About 1883, the United States Government recognized the merits of the Hindley worm-gears, and began using them on steering engines, windlasses, turrets, valve motions, etc., where a drive was required that would carry heavy loads subjected to shocks, or where it was essential to eliminate lost motion. Since that time, the applications for Hindley worm-gears have been multiplied, and some application of this type of gearing is now found in practically every industry.

The advantages of Hindley gears, as pointed out by Mr. Fleckenstein, are as follows: (1) They have a greater number of teeth in contact for a given pitch. (2) They can be made with a greater depth of tooth. (3) The teeth on the wheels have a straight side, which produces a flat bearing surface between the threads on the worm and the wheel teeth. On account of this fact, they have a greater bearing surface, and slide together correctly. Hindley worm-gears are especially adaptable for large reductions and high speeds.

The social side of the convention was, as usual at the Gear Manufacturers' meetings, well taken care of. The visiting members and guests were entertained at luncheon on the first day of the meeting by the New England members, and sightseeing trips and the usual informal dinner concluded this part of the program.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Becker Die-Sinking Machine. Becker Milling Machine Co., Hyde Park, Boston, Mass. 277
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Becker Die-Sinking Machine

A model D-1 die-sinker has recently been added to the line of milling machines built by the Becker Milling Machine Co., Hyde Park, Boston, Mass., which is said to have an exceptionally wide range and capacity. This machine was designed primarily for die-sinking, where an ample range is required owing to the size of the largest dies which run up to 10 tons in weight, and at the same time is capable of performing accurate die-sinking operations. The light spindle allows great ease of manipulation, which is necessary to get the delicate adjustment required to "follow the line" with convenience to the operator. This machine incorporates most of the improved features of the later types of milling machines manufactured by this company, together with many new and valuable improvements. It is rigidly constructed, and the knee, saddle, and table have been made exceptionally rugged. The knee, which is of great width, is elevated and lowered through two telescopic screws that are connected by gearing to move simultaneously, and being perfectly coordinated they are controlled by a single lever. In order to correct the alignment of the table, due to wear of the mechanism, an adjustment is provided on each screw. These screws also provide a double support for the knee, each screw being well out from the center of the machine to prevent undue deflection in the table, caused by the numerous stresses incident to the large overhang when the table is moved to its extreme limit on either side. The knee is also supported by the frame or column of the machine by means of the Becker patented knee gibbing. A horizontal cross-section of this gibbing is shown in Fig. 2. From this illustration it will be noticed that the forward pull on the gib is not carried by the screws holding the gib in place but by the locking construction of the gib itself, thus distributing the strain along the entire bearing surface of the frame.

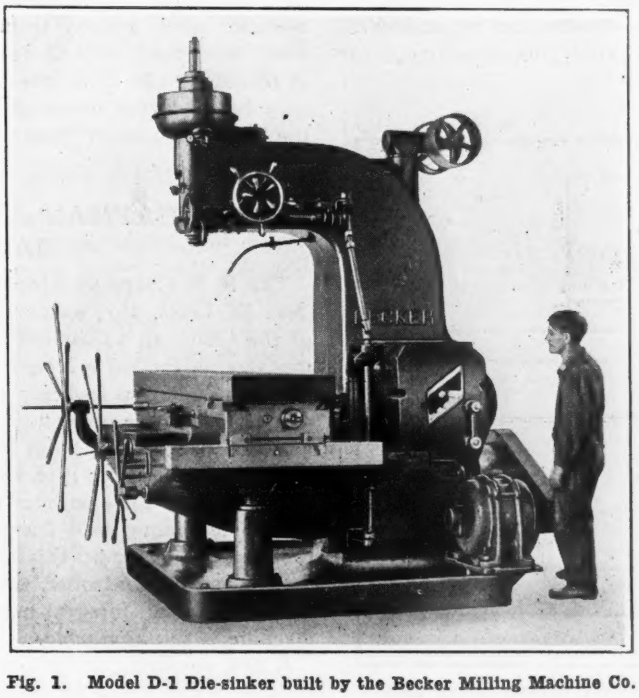


Fig. 1. Model D-1 Die-sinker built by the Becker Milling Machine Co.

The knee is reinforced by heavy ribs running in both directions, which are cast on the inside, and the spaces between the ribs on the top surface are closed by hand hole covers which prevent the accumulation of dirt and chips. The saddle is the same length as the table; namely, 96 inches, and slides on a tapered gib at the center of the knee, having in addition a wide flat way at each end; thus providing five generous bearing surfaces. The table is attached to the saddle by a straight gib and has a bearing the full length of the working surface, and it is provided with power rapid traverse in either direction; also a fine hand adjustment which is controlled from the front of the knee or at either end of the table. There are three ¾-inch T-slots in the table, oil-grooves on the side, and an oil-pan at each end for collecting the cutting lubricant which is returned to a tank cast in the base of the column by means of a flexible metallic tube.

A particular feature of this machine is the centralized control, which allows the operator, standing in his position at the front of the machine, to operate all hand and power feeds conveniently. Adjustable stops are provided for all of the various movements. The spindle is back-geared and driven by a 4-inch double waterproof belt, which transmits power to the spindle quite uniformly and gives to the work the smooth finish so much desired in die-sinking and similar work. The spindle is of the "barrel type" of construction and is provided with an adjustable automatic stop, a micrometer stop gage, fine hand adjustment, and a quick-return mechanism. The construction of the head is shown in Fig. 3. The spindle is made of crucible steel and it is carried in a conical sleeve bushed with hard bronze bearings. Collars are provided for adjusting to compensate for wear in the bearings. The end thrust is carried upon ball thrust bearings supported on

the end of the conical sleeve. This construction prevents the possible seizure of the spindle due to unequal expansion of the bronze and iron. The micrometer stop is located directly on the front of the spindle, this position having been found very convenient for setting operations. The stop and the slot in which it runs can be seen on the front of the spindle head in Fig. 1. In working out the design of this machine, the back-gears are located on the upper part of the head directly under the spindle driving pulley, and they are operated by a small lever projecting from the bottom of the bowl-shaped casting just beneath the spindle pulley. The feed-box is of the positive gear type. The feed is obtained from the lower drive shaft by a gear train to the feed-box. Eight feeds are obtained for each motor speed in geometrical progression, making it convenient to obtain any feed that may be most suitable for the particular job that is being done.

There are thirty-two feeds obtainable with a multi-speed motor and fifty-six feeds with the constant-speed motor, as follows: With an open belt, varying from 0.0024 to 0.0621 inch per spindle revolution, and with back-gears from 0.0126 to 0.3260 inch per spindle revolution.

There are fourteen spindle speeds obtainable when the power is supplied from lineshafting through the speed-box or from a constant-speed motor direct connected to the speed-box, varying from 73 to 438 revolutions per minute with open belt, and 14 to 83 revolutions per minute with back-gears. Eight spindle speeds are obtainable when the power is supplied by a multi-speed motor varying from 149 to 447 revolutions per minute with the open belt, and from 28 to 84 revolutions per minute with the back-gears.

The spindle is provided with a draw-bar and is stopped and started by a treadle at the left of the base, when constant speed is provided. The moving member of the clutches for engaging the power rapid traverse to the table is so made that it is impossible for both to be engaged at the same time. When motor drive is desired, the motor is placed on an extension of the base of the machine at the right side at the rear. A 7½-horsepower constant-speed motor running at 1200 revolutions per minute, or a 7½-horsepower multi-speed motor with speeds of 600, 900, 1200 and 1800 revolutions per minute, or a 7½-horsepower variable-speed motor having a ratio of 3 to 1, is recommended. When either a multi-speed or a variable-speed motor is used, the speed-box is not necessary.

Extras, such as arbor supports, an oil-pump with connections, a rotary table with a circular top graduated to 360 degrees, having a working surface 30 inches in diameter and a draw-in chuck for holding cutters, can be furnished. Another important device is the cherrying attachment for die-sinking.

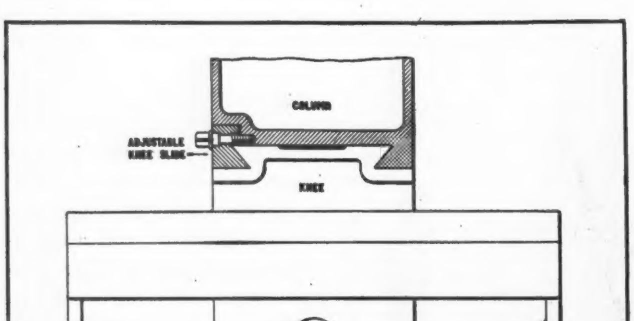


Fig. 2. Horizontal Cross-section of the Gibbing in the Knee

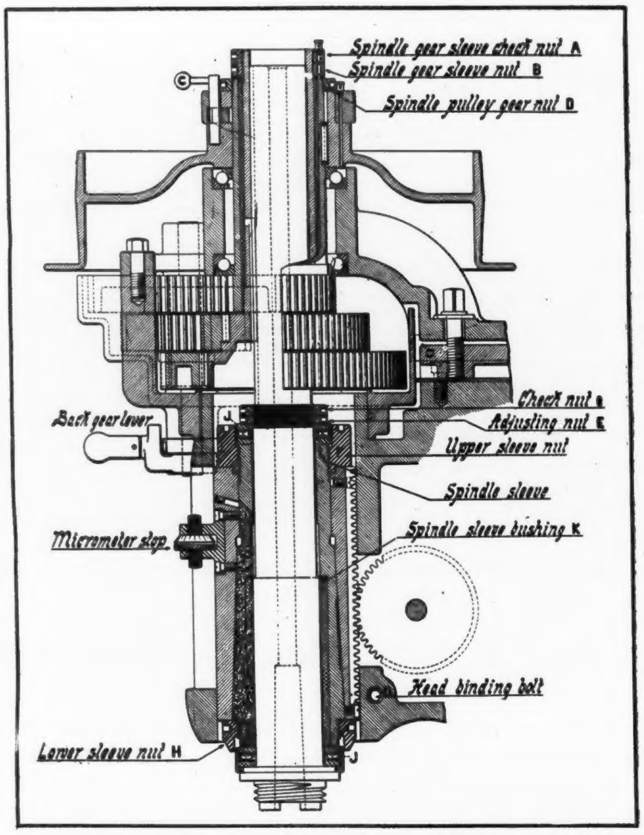


Fig. 3. Construction of the Head of the Becker Model D-1 Die-sinker

PRECISION THREAD GRINDER

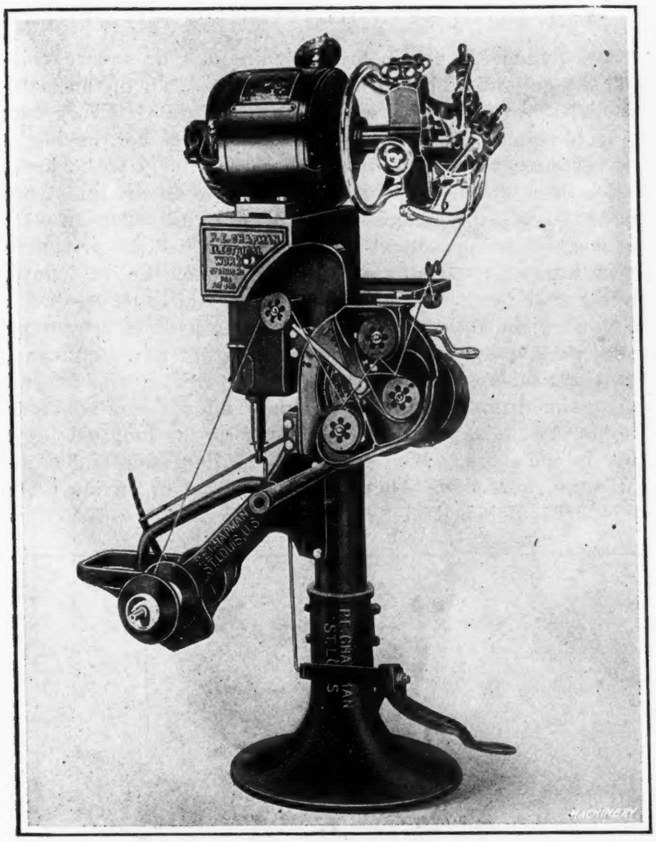
The thread grinding machine built by the Precision & Thread Grinder Mfg. Co., 1932-1934 Arch St., Philadelphia, Pa., has been improved by attaching the arm used when dressing the wheel to the base of the machine, instead of to the housing slide. The advantage gained by this arrangement is that the correct angle can be obtained when dressing the wheel, because of the accurate alignment which is made possible with the axis of the work. The new arrangement of the arm also permits a 5-inch wheel to be used.

The adjusting screws for the slide are made with finer pitch than formerly, and they are also made left-hand so as to be more handy to operate. An electric switch has been placed in the line, within a few inches of the machine, so that the power for the motor can be controlled without the operator moving away from the machine. Stop-pins have been introduced on the arm used for dressing the wheel at 60-degree and 55-degree positions, so that rapid settings may be made for dressing the wheels for grinding either the U. S. standard or Whitworth standard threads.

P. E. CHAPMAN ARMATURE WINDING MACHINE

The P. E. Chapman Electrical Works, Tenth and Walnut Sts., St. Louis, Mo., announce a much more complete model of the Chapman adjustable bipolar drum armature winding machine, in the Style 3 equipment as shown herewith. This model, in addition to being adjustable in a few minutes for any style and size of random wound bipolar drum armatures and any size of wire from No. 20 to No. 36, has some special features enabling it to wind a very great amount of wire into armature slots without pounding the wire, and it also has some unique lead forming and handling features for reducing the labor on this part of armature winding. The driving motor, controller, turn counter and other necessary members are all integral parts of the machine; in fact, the machine is self contained.

A new automatic dynamometer controlled reel-holder and tension device has been perfected, which it is claimed stops



Armature Winding Machine built by the P. E. Chapman Electrical Works

all spool troubles and enables quick starting, high speed, great tension and quick stops, so that only about five seconds are required to wind in a coil. This reel-holder and tension device are simultaneously adjusted for any sizes of wire by a simple crank, and once adjusted need no further attention until the reel is empty. It is said that the announcement of this device has been held back long enough to prove the machine a success in actual practice. In one case an output of nearly 600 per day was obtained where the estimate was 200 to 250. It is claimed that the output of the machine runs into hundreds of armatures per day on many sizes and kinds of armatures; that the saving over hand winding usually is anywhere from 10 to 30 to 1 or even better, and that the machine is easy to operate, well and strongly built; that it is useful both in the jobbing shop and in the factory. The machine is also useful for winding field coils, smaller armature coils, etc.

LAFAYETTE UNIVERSAL GRINDER

The Lafayette Tool & Equipment Co., 21 S. 12th St., Philadelphia, Pa., has recently placed on the market a universal grinder for precision tool-room work. This machine is illustrated in Fig. 1. While one of its most obvious applications is on a tool-room lathe for both internal and external thread gage grinding, this machine is also intended as a grinding machine when used on the bench, and as a grinding attachment to be applied to lathes, milling machines, shapers, planers, etc., to handle a variety of work. The grinding wheel spindle bearing housing has a longitudinal movement in a saddle, which in turn has a vertical movement on the column. A swivel is provided with a protractor of a large radius for inclining the grinding wheel spindle, when thread grinding, to suit the helix angle. Micrometer dials are provided for both longitudinal and vertical adjustments, making it very convenient to obtain accurate settings whenever required for precision work. This machine is designed and manufactured for grinding within 0.0001 inch, and all of its parts are interchangeable.

Realizing the importance of service rendered by the spindle construction in a precision grinder running at 25,000 revolutions per minute, which is required to produce work that is accurate within 0.0001 inch, the manufacturers have developed a style of spindle which they claim to be entirely free from vibration, even under the most severe working conditions, and one which will produce an unusually smooth finish. The spindle is made of a special analysis steel, hardened and ground, and the bearings are of Non-Gran bronze, lubricated from a reservoir of oil and protected against oil leakage, dirt and grit by felt washers. The bearings are tapered and readily adjustable for wear. The driving shaft is independent of the grinding wheel spindle, preventing transmission of pull from the driving belt and allowing the wheel perfect freedom of operation. Adjustment is provided for belt tension, and the grinding wheel has downward action, so there is no danger to the eyes of the operator. A General Electric universal motor is furnished, which can operate from any 110-volt circuit whether direct or alternating current.

Means which are provided for truing the grinding wheel make this machine very suitable for thread gage grinding as well as for general purposes. The wheel truing device is designed to accommodate three diamonds, and graduations at the base of the truing device permit of setting it at any angle. Adjustable stops as well as means for locking are provided, and the truing device bracket is adjustable vertically in reference to the column to secure proper alignment. It will be noted that when thread grinding, the wheel is trued in the horizontal plane of the center line of the work and lathe spindle. It sometimes happens, particularly when grinding internal threads, that there is no room for the truing attachment when actually grinding. An adjustable stop is furnished which enables the truing device bracket to be rapidly attached to the column at the proper height. The bracket is quickly clamped to the column by a stud with an interrupted thread.

For grinding deep holes and long internal threads, the manufacturers have developed an extension spindle and an extension spindle bearing housing. The application of these features to the Lafayette universal grinder is illustrated in Fig. 2. Non-Gran bronze bearings are also used in the extension spindle bearing housing. When used together with a surface plate, this machine is very suitable for surface grinding. Fig. 3 shows the adaptation of the Lafayette universal grinder to the grinding of circular forming tools. With the use of other simple adapters, securing the work to the rack, this machine can be used for a variety of bench grinding. With the use of an extra rack holding device, it

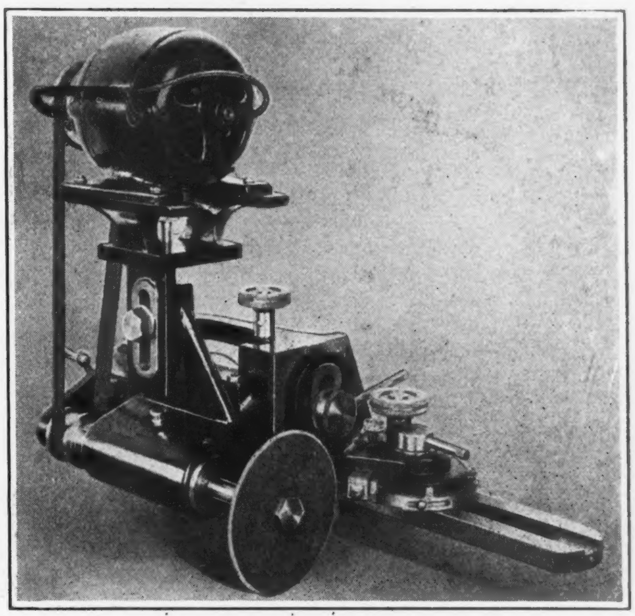


Fig. 1. Universal Grinding Machine built by the Lafayette Tool & Equipment Co.

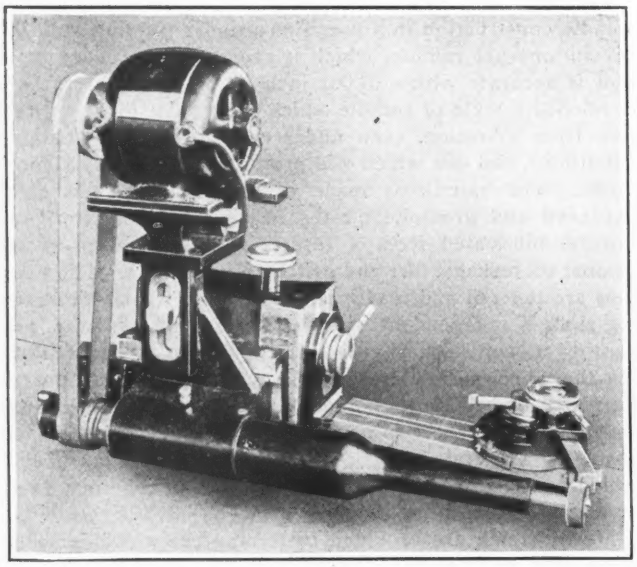


Fig. 2. Lafayette Universal Grinder equipped for handling Internal Work

is not necessary to remove the work in order to true the wheel, and the diamonds are always in the correct position for truing.

In addition to the specific uses referred to in the foregoing, this machine when applied to a lathe, may be used for cylindrical, taper, and internal grinding. Used with the relieving attachment on the lathe, taps, cutters, etc., are relieved by grinding after hardening. This grinder may be used for grinding cutters in position on the milling machine, and when clamped to the overarm of the milling machine, it may be used for surface grinding, or clamped vertically to the overarm bracket of the milling machine, it may be used for finishing dies of various kinds. The use of pencil grinding wheels is recommended for the grinding of dies. This machine may also be attached to shapers and planers for surface grinding and a variety of other purposes. It will be readily seen that the machine is quite universal in character and that its many applications make it possible to adapt it to a great many uses either in tool-room or special work or in precision manufacturing processes.

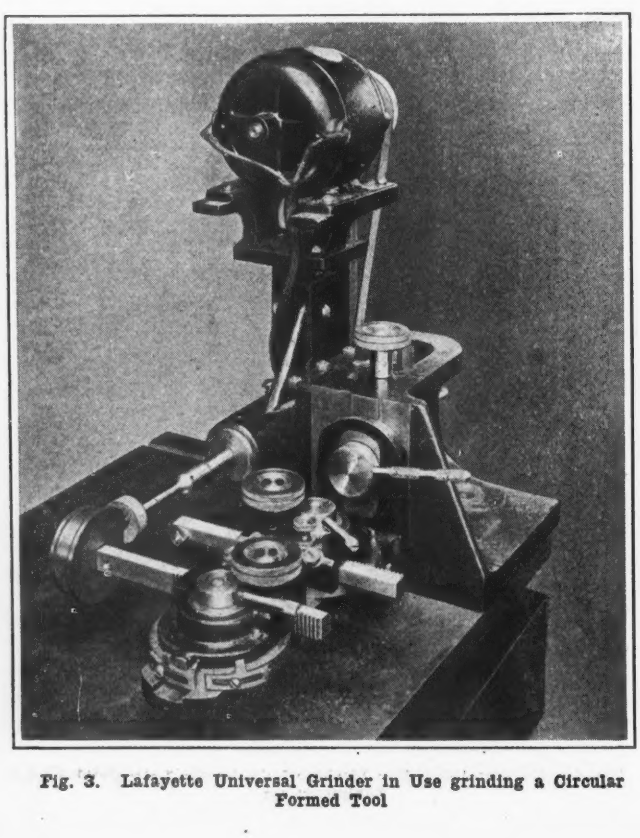
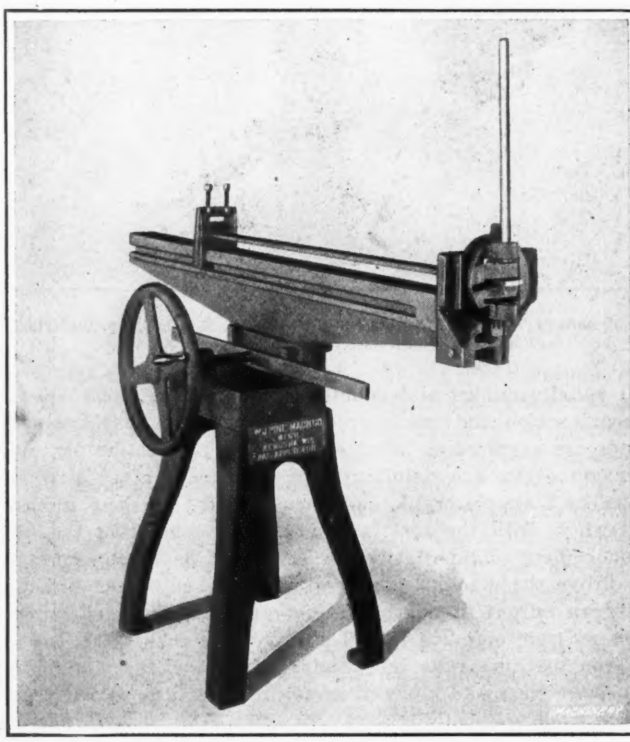


Fig. 3. Lafayette Universal Grinder in Use grinding a Circular Formed Tool

W. J. PINE STRAIGHTENING MACHINE

A machine for use in straightening flat or square cold-rolled steel and which also takes the twist out of the material is shown in the accompanying illustration. Every user of cold-rolled steel knows of the necessity for having it straightened ready for use, as there are likely to be kinks and twists which would cause trouble if an attempt were made to work the material while irregularities of form were present. It is impracticable to use cold-rolled flat or square stock where one edge or side is to be broken the full length, owing to the existence of strains which will cause the stock to bow. Cold-rolled flat stock could be used to advantage for a great many purposes where it is not now employed, if a practical machine for straightening were available, and it is claimed that the present machine affords a satisfactory method by the application of pressure on the long side of a kink in the work, which contracts the long side and elongates the short side. There is an upper bar or testing table on which stock is laid to find the kinks, after which it is



Machine built by the W. J. Pine Machine Co. for straightening Square or Flat Cold-rolled Steel

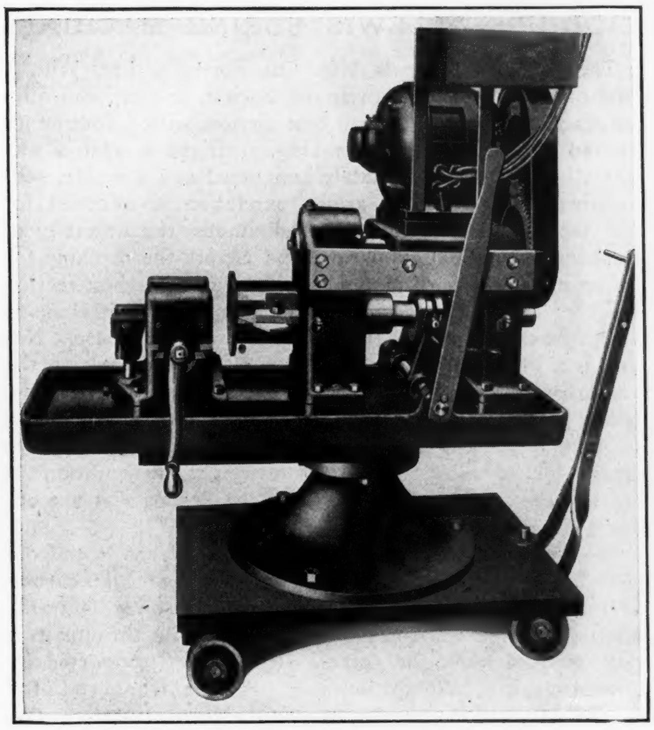
placed under the pressure screw which is conveniently arranged for the purpose. When used to take the twist out of stock, one end of the work is clamped in a yoke vise, and the other in the twisting head vise. This machine also provides a convenient means for the performance of such operations as offsetting connecting-rods and bars, and bending irregular shapes in forms or dies, where the application of pressure is required. Machines of this type are built in four sizes with testing tables 6, 8, 10 and 12 feet in length, and all sizes except the smallest have the straightening screw and twisting head compounded to afford the increased leverage that is required in handling larger stock. This machine is a recent product of the W. J. Pine Machine Co., 411-415 Jenne St., Kenosha, Wis.

"NAMCO" BAR POINTING MACHINE

For preparing raw material for use on automatic machines of its manufacture, the National Acme Co., Cleveland, Ohio, has recently perfected and placed upon the market the "Namco" bar pointing machine, which is here illustrated and described. This machine was first built to meet the requirements of the National Acme Co.'s screw machine product business, which includes the cutting from the bar of vast

quantities of different classes of work. The design of this machine is therefore based upon this company's experience in operating automatics, and the constant effort which is made in its plant to discover faster methods of manufacture where quantity production is desired.

On this bar pointing machine, the operating mechanism is of a very simple design, consisting mainly of a gear-driven spindle carrying a plain turning tool in a revolving cutter-head, a chuck, and a hand-lever. The chuck is provided with jaws which are quickly adjustable to accommodate practically all diameters and shapes of bars. Round bars are pushed into the chuck, gripped, and the tool fed to the bar by the hand-lever. Hexagonal and square stock is even easier to handle than round bars, as no gripping is required. It is simply pushed against the tool, which revolves in one position, and withdrawn, requiring only one movement of the operator.

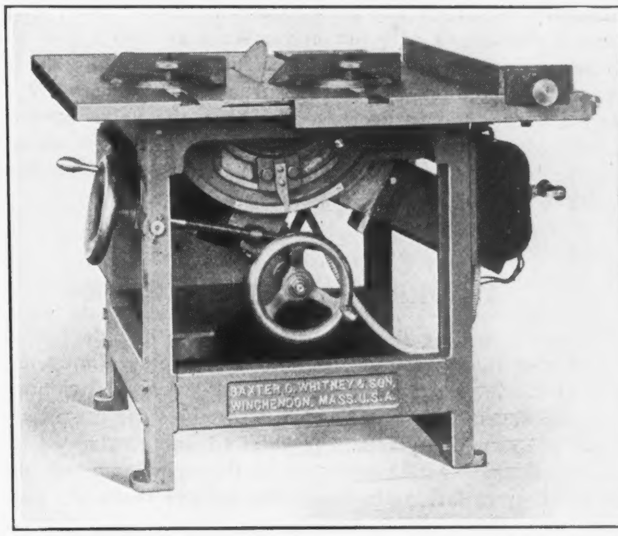


"Namco" Bar Pointing Machine built by the National Acme Co.

Where quantities of work are handled by two machines operating end to end, advantageous results may be obtained. Two men who hold the bar near opposite ends lift it to one machine and then to the other, thus pointing both ends with two movements. On heavy work, two men on two machines point nearly twice the number of bars that can be done on a single machine. The machine is mounted on a truck for convenient hauling from one stock-bin to another, and is frequently used as the stock is taken from the freight cars, thus saving much of the expense of a second handling. It is driven by a 1-horsepower motor.

WHITNEY MOTOR-DRIVEN SAW BENCH

Baxter D. Whitney & Son, Winchendon, Mass., have recently added to their line of woodworking machinery a direct motor-driven saw bench with a tilting arbor. In the construction of this machine, the same motor drive has been employed that is successfully used on other machinery of this company's manufacture. Two motors having a speed of 3450 revolutions per minute are mounted directly on the saw arbor. The motor housings are a part of the yoke carrying the saw arbor and the ball bearings, all of which are tilted as a single unit to secure the desired bevel of cut for the saw, instead of employing the method of tilting the table. The frame of the machine is so designed that it

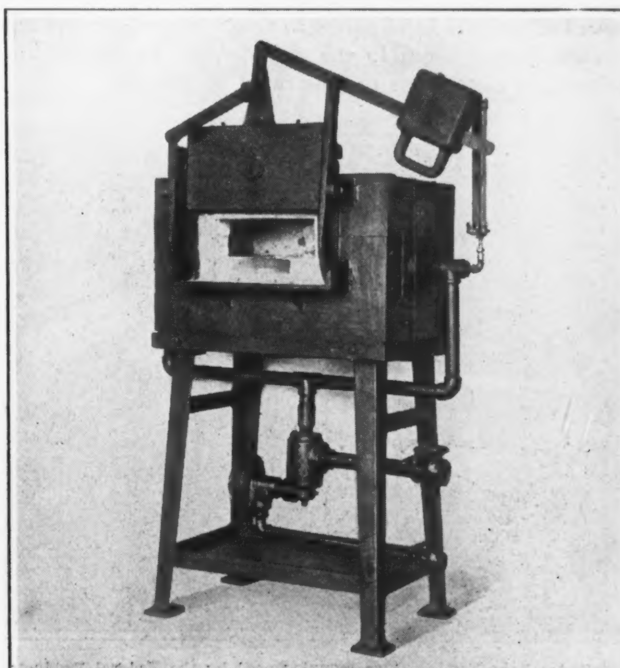


Motor-driven Saw Bench built by Baxter D. Whitney & Son

allows easy access to all working parts, and permits the operator to get close up to the saw. Guiding of the yoke that carries the saw arbor and motors is accomplished by a circular groove having a wide bearing surface. It is also raised or lowered independently in dovetailed ways. By means of a handwheel the saw arbor can be tilted to saw at any desired angle up to 45 degrees.

SURFACE COMBUSTION OVEN FURNACE

In the accompanying illustration there is shown a Type A-25 oven furnace built by the Surface Combustion Co., 366-368 Girard Ave., Bronx, N. Y. This furnace is equipped with a special door-lifting mechanism that has recently been developed, the design of which was worked out after a careful study of practical requirements. A link motion is employed for this purpose, which not only allows the door to move up and down vertically, but effectually prevents it from making any other movement. Simplicity and compactness of construction are claimed for this mechanism, and it is stated that a furnace door equipped in this way tends to remain either in the open or closed position without relying on friction to hold it there.



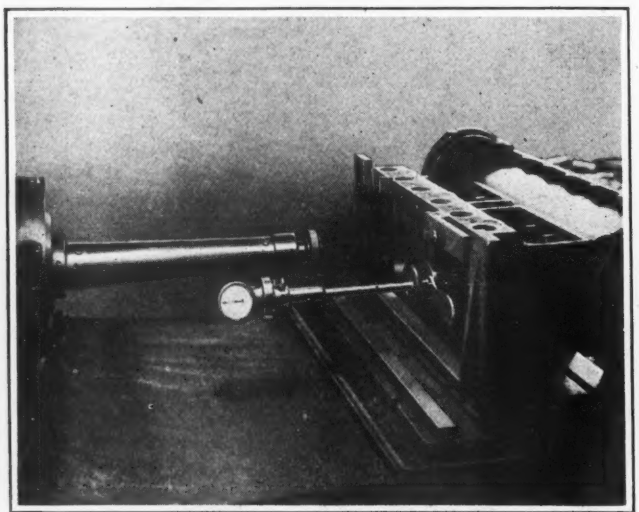
Type A-25 Oven Furnace built by the Surface Combustion Co.

This furnace is equipped with an automatic air and gas proportioner, which has a one-valve control. This equipment is the means of constantly mixing air and gas in the proper ratio for complete and perfect combustion. To increase the temperature of the furnace, this one valve is opened wider, and to decrease the heat, the valve opening is reduced. A perfect mixture of gas and air is maintained and the proportioner is arranged so that it is independent of either skill or carelessness of the workmen.

CYLINDER TESTING MACHINE

For use in testing the bore of gas engine cylinders when accuracy of the bore must be held within close limits, the Federal Products Corporation, 393 Harris Ave., Providence, R. I., has developed a gage which determines the magnitude of any errors which exist. The chief advantage claimed for this tool is that there are feelers in the cylinder which detect existing variations in the diameter, and these are indicated by a dial which is outside the cylinder within clear view of the operator. The general arrangement of the gage will be readily understood by referring to the accompanying illustration, where it is shown in place in an automobile engine cylinder.

The method of operating this gage is as follows: Any existing variations in the diameter result in movement of the gage feelers, the inner ends of which are held against a cone cam by means of springs. This cam is directly connected with a steel rod running through the outer casing to a rack and spur movement, which moves a needle over the gage dial. A lever is also attached to the steel rod by means of which the cone cam is lowered, thus permitting the feelers to recede sufficiently to be inserted in the cylinder. After the feelers have been entered in the bore, pressure on the lever is withdrawn and the feelers are automatically released against the inside of the cylinder. A centralizing support holds the apparatus in position, this support being placed at the mouth of the cylinder. It has three fingers which bind firmly against the wall of the cylinder. The gage body turns freely, and slides in and out through the centralizing support, thus permitting the feelers to bear against the cylinder wall at any desired position. Graduations of the gage dial represent 0.001 inch, and the dial can be turned to any position on its axis so that readings can be taken where the light will illuminate the dial most favorably. The feelers are set to a master gage corresponding to the bore of the cylinder, the dial of which is turned so that the hand points to zero. Then when the feelers are moved about in the cylinder, all variations from the correct dimensions are indicated on the dial.



Cylinder Bore Testing Gage manufactured by the Federal Products Corporation

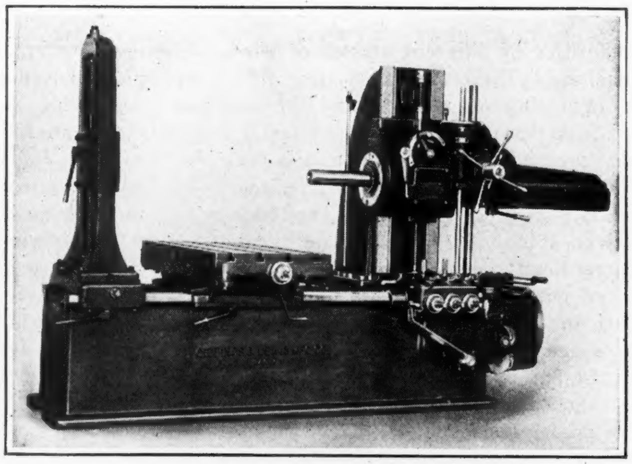


Fig. 1. No. 45 Horizontal Boring, Drilling, and Milling Machine built by the Giddings & Lewis Mfg. Co.

GIDDINGS & LEWIS BORING MACHINES

The Giddings & Lewis Mfg. Co., Fond Du Lac, Wis., is now building a No. 45 horizontal boring, drilling, and milling machine. The body is of box section, with a continuous trussed bottom and direct ribbing, arranged in such a way that all strains are adequately supported and a stable, self-contained, three-point bearing foundation is afforded for the machine. This type of bed eliminates the necessity of preparing a special foundation, and adapts the machine for use on upper floors of manufacturing plants. A box section was also adopted in designing the column, and it is made with a liberal spread in both directions at the base. Not only is a liberal bearing provided for the headstock on the column with a minimum overhang of the spindle, but the design has been worked out to combine the features of long inner guide ways located close to the center of gravity, two square locked gibs and a counterweight, in addition to which there are several features of the design that are entirely distinctive in this machine.

The stub-toothed spindle driving gears are cut from carbon steel forgings, and they are mounted on high-carbon steel shafts running in bronze bearings. Power is transmitted from the spindle sleeve to the spindle through two long opposed keys, the spindle sleeve being supported by tapered bronze take-up journals. At the front end, the spindle is bored to receive standard Morse taper shanks, and it is slotted to receive a retaining key and drift. A take-up device at both extreme ends of the sleeve provides for accurately maintaining the spindle alignment. The spindle control is directly in front of the operator, which is an important feature, as it permits absolute control of the spindle while guiding the tool into the cut. This pilot contains a quick-acting positive knock-out clutch which is a part of the self-locking worm-gearing, and is coupled directly to the pinion, meshing with the rack that leads back to the ram. A positive binder is provided for locking the spindle feed, and also a handwheel for making slow precision adjustments.

For handling extra large work, the end support can be quickly removed and replaced without affecting the alignment. Accurate alignment between the outer support and the spindle is assured; and should this alignment be affected, means of making a fine adjustment are provided at the top of the suspended elevating screw. A strongly ribbed, one-piece casting is used in making the table which is provided with a cutting solution trough, and deep T-slots are provided for securing the work, and also a positive binder for locking. The table is fed along narrow guide ways by means of a screw provided with ball thrust bearings at each end, and the ways are gibbed to provide for making adjustments. The front edge of the table is always at right angles to the spindle.

Square locked gibs are provided on the long and narrow saddle ways, which are positioned at an ample distance

apart to assure a rigid construction. Perfect support is provided for the table without the use of complex compound bearings. Adjustable stops provide for accurately regulating both extremes of the feed movement.

Power for the speed case is provided by a single pulley with an outboard bearing support. This pulley can be quickly moved to the end or rear, thus eliminating the necessity of ever having a twisted belt. Independent of the driving pulley, and inside of the oil-tight case, there is a reversing friction clutch for the whole machine, which is controlled by a single lever positioned close to the operator. Speed changes are provided by wide-faced stub-toothed gears made of heat-treated chrome-nickel steel. Power for the feed mechanism is furnished through a set of change-gears by means of which any rate of feed not shown on the index-plate can be readily obtained. As in the case of the speed gears, these feed-gears are also made of heat-treated chrome-nickel steel, and have stub teeth. The rapid traverse takes its power direct from the initial speed shaft through large diameter steel spur gears, thus producing a constant rapid power adjustment which is brought into action by disengaging the positive feed clutch and engaging the large diameter friction.

An independent feed reverse is available, which is so designed that it engages the rapid traverse only in the opposite direction to the feed. The transmission case receives its power through a patented pressure adjusting speed device. A separate lever is provided for each selective feed, the levers being interlocked. On the front end of each transverse shaft there is placed a micrometer dial marked to 0.001 inch, to facilitate hand setting. Each shank has a clutch for engaging a safety hand-crank, and the screws leading from this case are of large diameter and coarse pitch. All operating levers on the machine are located within a horizontal space of approximately two feet and high enough from the floor to avoid the necessity of having the operator stoop under the working position.

When conditions are favorable, it will be found economical to equip machines of this type with a secondary opposed spindle as shown in Fig. 2. Such an arrangement is provided for by making a left-hand headstock and column. In the saddle there is contained the necessary gearing to operate this end of the machine, either independently or in unison with the opposite end. The gearing required to feed or rapidly traverse this saddle along the bed is also contained in the saddle. It receives its speed movement from the standard transmission case, and consequently has the same arrangement of feeds and rapid traverse movements. The feeds can be reversed at either end of the machine. Power for the speed mechanism is taken from the final shaft in the standard speed case, and therefore provides the same range of speeds which are available at the opposite end. Reversal can be accomplished from either end of the machine. A secondary table and saddle can also be provided, which will feed in unison or independently.

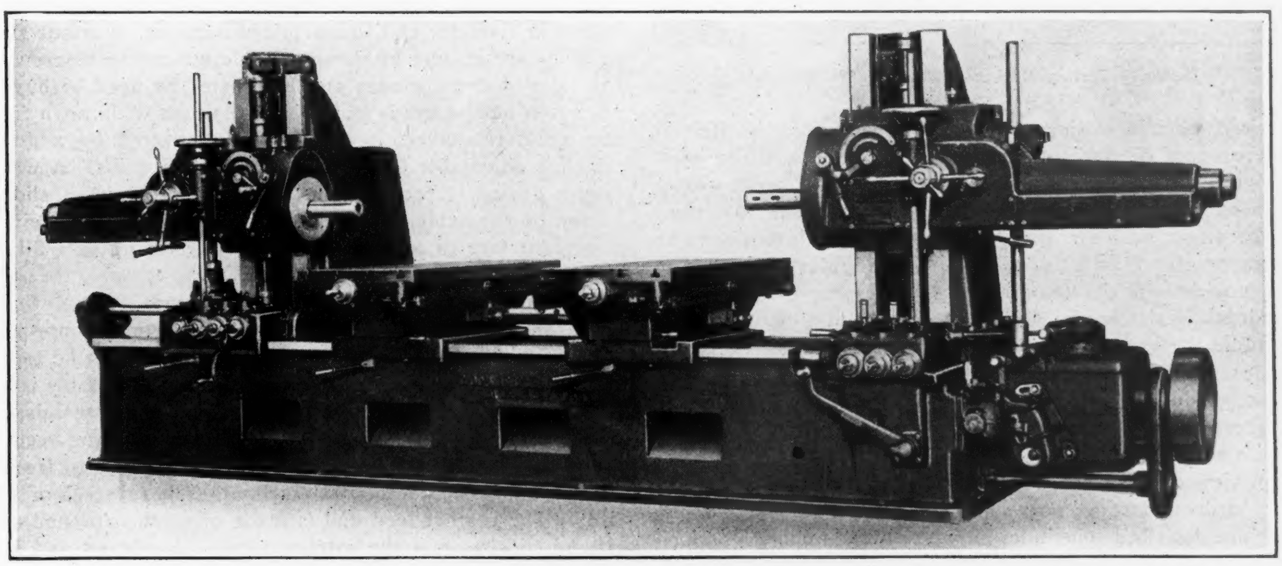


Fig. 2. Giddings & Lewis Duplex Boring, Drilling, and Milling Machine equipped with Opposed Spindles and Two Work-tables

ROCKWELL HARDNESS TESTER

For use in testing the hardness of all kinds of metals by the Brinell method, S. P. Rockwell, 122 Dickerson St., Syracuse, N. Y., is now making a testing machine which is here illustrated and described. It is claimed that this machine gives very accurate results and that it is adapted for testing both curved or flat surfaces and either thin or thick sections. It operates rapidly, and may be carried around without trouble. Another important feature is that it does not excessively mark or destroy the work on which a test is made, and that the machine is adapted for testing the hardness of all metals ranging from lead to hardened steel. The machine consists of a sturdy hollow cast frame and a plunger, which holds the testing point at one end and abuts against a delicate measuring device at the other end. A series of levers with knife-edges connects this plunger with a weight, and by shifting the position of the weight, more or less force may be applied to the testing point to suit conditions.

A vertical moveable chuck holds the piece on which a hardness test is to be made, this chuck being actuated by a handwheel. The piece to be tested is placed in this chuck and raised by the handwheel until it comes into contact with the testing point. At this moment, the initial pressure is applied through the point to the work, in order to cause the point to break through the light scale, decarbonization, etc., so that it may more clearly test the condition of the true metal beneath. Upward movement of the work is continued until the plunger has actuated the measuring device to a degree sufficient for testing; then the final weight is applied by a hand-lever, and the hardness is read direct by the difference of the testing point's position as indicated by a measuring device. The elasticity of the metal may also be determined by the test point's difference of position from final pressure to initial pressure.

With an equipment of this kind, an average operator can readily make six tests per minute. The greatest value of this machine for shop use is as a comparative tester. For such work, hardness limits are established by the Brinell, scleroscope, file, or working tests, and the Rockwell hardness tester is then set for the particular class of work on which it is to be used, and its limits are established. If so

Hardness Testing Machine built by S. P. Rockwell

desired, the indicating dial can be calibrated in Brinell, scleroscope, or percentage hardness numbers, using electrolytic iron as zero per cent soft. Such dials are available as a special equipment. All work has allowable variations in hardness, and for fast operation of this instrument an extra pointer may be provided. The angular difference in the position of the two pointers represents the allowable hardness variation; and if in operation the two pointers straddle the graduation indicating mean hardness, the work comes within the specified limits. Failure to straddle the mean graduation indicates that the work is too hard if the pointers are on one side, or too soft if they are at the opposite side.

In view of the increasing need for readily applicable means for hardness testing, convenient and simple to operate, the machine described constitutes an interesting development which will, in addition to other means already available, make it possible to control the quality of manufactured articles, especially those subjected to various heat-treatments.

OTT INTERNAL GRINDING MACHINE

The Ott Grinder Co., 217 W. 10th St., Indianapolis, Ind., is now building for the market a 6- by 6-inch internal grinder which was designed by George L. Scoville, chief engineer of the company. This machine has been in operation at the Ott plant for a period of eight months and during the trial it is claimed that very satisfactory results have been obtained. It is also stated that the design has been simplified as far as it was possible to do, and still provide for the rapid and accurate grinding of straight and tapered holes that come within the capacity of this machine.

The headstock or work-head is of box construction, with the tight and loose pulleys enclosed. At a single motion the operator shifts the driving belt to the loose pulley and applies a brake to the tight pulley, thus stopping the work. The loose pulley is mounted on Hyatt roller bearings. Provision is made for swiveling the base of the headstock 60 degrees on each side of the center line for the performance of taper grinding operations. Four work-speeds, covering a range of 85 to 425 revolutions per minute are provided. The spindle is made of high-carbon steel heat-treated and ground to size. It revolves in Non-Gran bearings which are adjustable for wear. These bearings are fully protected from grit, and ample means of lubrication are provided. The diameter of the spindle is 2 inches in the bearings, and the nose is threaded with a 2-inch diameter for a distance of 4½ inches.

The minimum bore through the spindle is 1¼ inches in diameter and the nose is tapered inside to receive spring chucks or collets having a range for work from 1/16 to 1 inch in diameter. A quick-closing lever-operated device is provided for use with these collets and also for use with a 9-inch adjustable three-jaw collet chuck. It is claimed that this device will grip each piece of work equally hard or light as desired. The 9-inch adjustable collet chuck is a regular equipment and will hold work of all diameters from ½ to 9 inches. Work 10 inches in diameter can be swung inside of the water guard, and pieces up to 12 inches in diameter can be handled outside of the guard.

A single solid casting is employed for making the wheel-spindle head, in which the wheel-spindle is mounted on three double row S. K. F. ball bearings. This head also carries the jack pulley which increases the speed from the countershaft to the wheel-spindle. This pulley is mounted on Hyatt high-speed roller bearings and swings on an adjustable arm to compensate for the stretch of the endless belt. Changes of wheel speed are accomplished through this pulley and cover a range from 8,000 to 20,000 revolutions per minute. The spindle is designed to grind holes from ½ inch to 6 inches in diameter and to a depth of 6 inches. Various sizes of holes are ground by using suitable quills which screw on the tapered spindle nose and eliminate the need of buying several complete heads and spindles. When withdrawn from the work, the wheel is automatically covered by a guard which is adjustable for different lengths of quills. A wheel truing device is provided, which is mounted on a sliding bridge on the table. The wheel can be dressed with either a straight face or a concave or convex face up to a 3-inch radius.

The table drive is accomplished through a steel worm and bronze worm-wheel, which are driven from a four-speed transmission case to a steel rack and pinion connected to the sliding table. Accuracy of reversal of the sliding table is accomplished by a non-centering device in the transmission case which operates the reversing clutches. Hand feed is graduated to 0.00025 inch and will automatically feed from a minimum of 0.00025 to 0.003 inch at each reversal of the table. The ratchet feed dial is made of steel, hardened and ground to size, and the ratchet pawl is hardened and follows the dial in the same arc of the circle, thus eliminating wear. The water tank and Fulflo pump are bolted to the

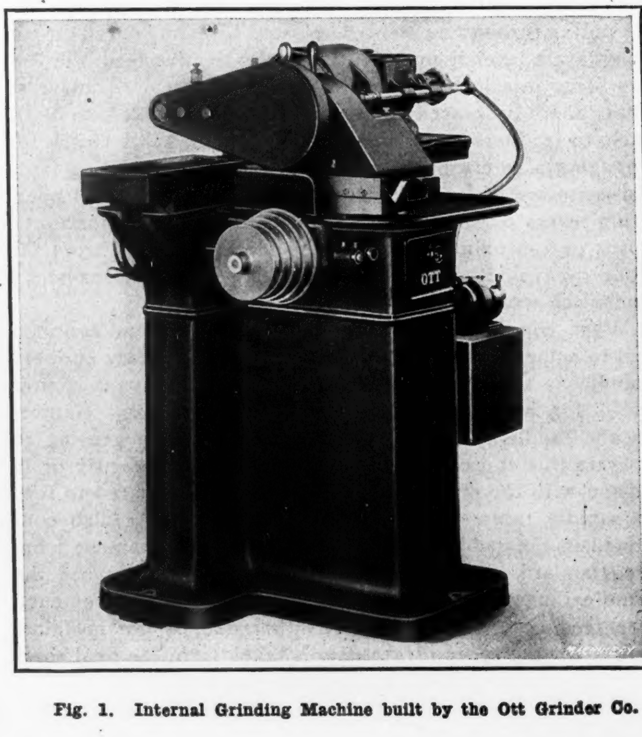


Fig. 1. Internal Grinding Machine built by the Ott Grinder Co.

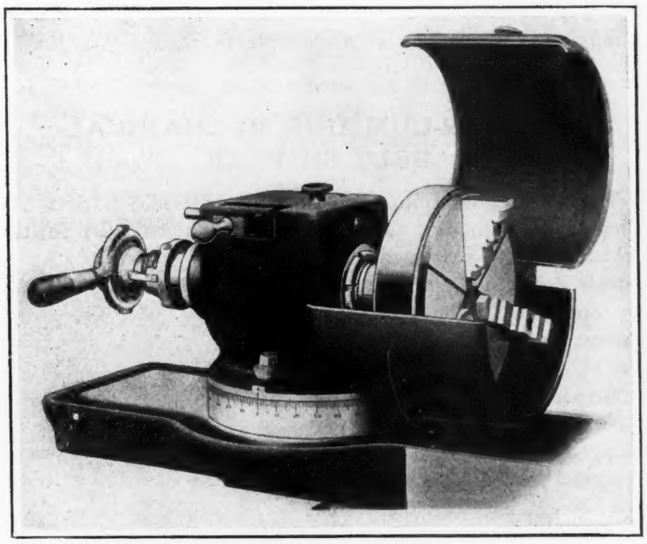
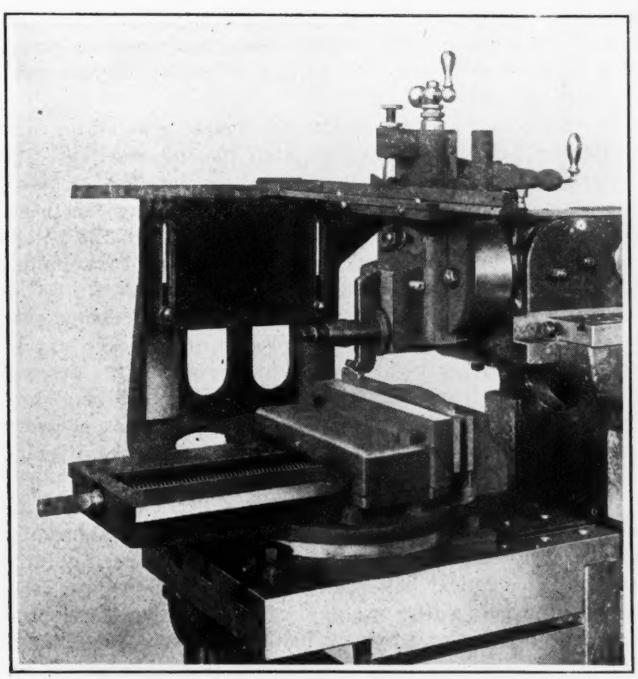


Fig. 2. Close View of Headstock of Ott Internal Grinding Machine

base of the machine, and a metal flexible hose is used to bring water to the work from either the rear and through the spindle, or directly to the work from the front.

STOCKBRIDGE SHAPER ATTACHMENT

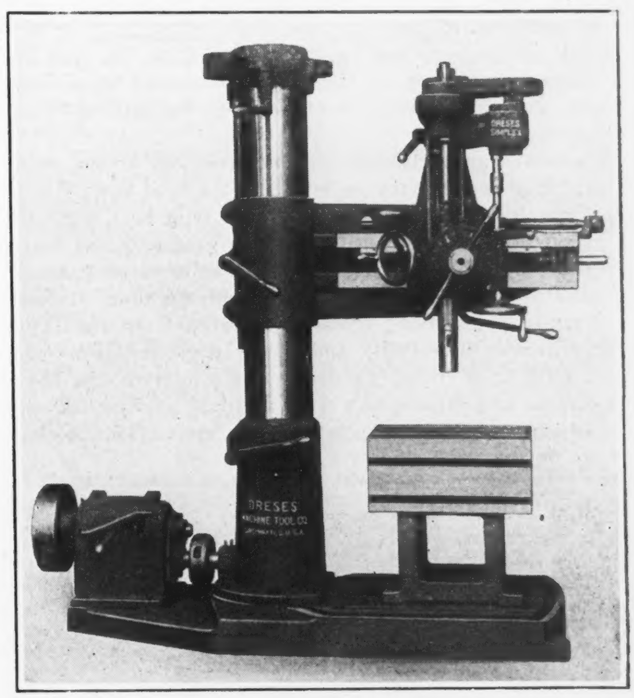
For use in following irregular curves with a shaper, the Stockbridge Machine Co., Worcester, Mass., has developed a device known as an irregular curving attachment, which is adapted for use on shapers of standard design. Such operations have to be performed on split dies and many other classes of work; and the range of angles and curves that this attachment will machine is quite broad. In addition to its application on various forms of dies, this device is also useful in machining bending forms, formed tools, etc. In operation, the principle is for the tool to reproduce the curve of a templet, and the reproduction can be repeated as many times as necessary. The templet is carried on the cross-slide holder and is usually made from about ½ by ¼ inch stock shaped to the required outline of the work to be cut. The cutting tool is located directly beneath the follower, and is raised or lowered as the follower moves along on the surface of the templet, thus reproducing its curves and angles. Attachments of this type can be furnished for use on all sizes of Stockbridge shapers, and are interchangeable with the regular Stockbridge shaper head. They can be furnished either on the shaper without the regular head, or as an addition to the head.



Shaper Attachment built by the Stockbridge Machine Co. for following Irregular Shaped Outlines

DRESES SIMPLEX RADIAL DRILLING MACHINE

The accompanying illustration shows a radial drilling machine which is built in 2-, 2½- and 3-foot sizes by the Dreses Machine Tool Co., Cincinnati, Ohio. These radial drilling machines have been so designed that they are adapted for operation at high speed, and for handling heavy-duty work; also, the design is so simple that the machines may be operated by unskilled labor. All parts of the mechanism are centralized, and the number of parts has been reduced as far as possible. Noiseless operation is attained by the use of a helical gear drive, with metal gears meshing with fabric gears. The outer column swings on a fixed inner column reaching to the top, and in addition to the upper and lower bearings there is a third bearing at the middle that gives additional strength and rigidity to the machine. A convenient feature is that of having the clamping handle follow the arm, so that it is always within reach of the operator. The outer column rests on a ball thrust bearing on the top of the inner column, which insures easy swinging of the arm; and the arm is lowered and raised at a ratio of 2 to 1 by a conveniently located handle which is locked to avoid accidental engagement of the mechanism.



Radial Drilling Machine built in 2-, 2½- and 3-foot Sizes by the Dreses Machine Tool Co.

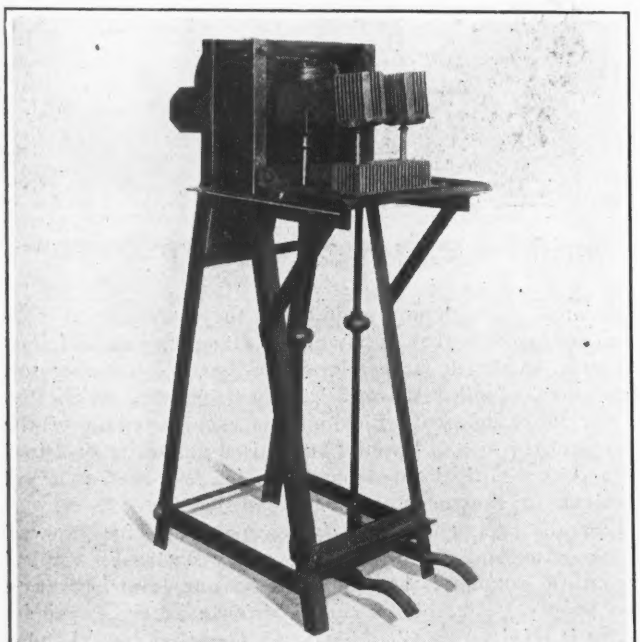
Liberally proportioned bearings are provided for the head on the arm, and the head is moved by means of a spiral pinion. Clamping is accomplished by one lever operating two screws. The spindle runs in bronze bearings, and its thrust is received by a ball bearing. There are four changes of feed, any of which is obtained by manipulating a knob on the head feed shaft. Feed and speed plates are attached in conspicuous positions on the machine. The automatic stop used on this machine is of the dial index type, and a safety release is provided at the end of the rack. Quick-return movements are obtained by either of the two handles which engage and disengage the mechanism through a positive clutch. Frictions are used in starting, stopping, and reversing, with the friction bevel gears encased in the back

of the head. These gears run in oil. There are six changes of speed, and a convenient form of shock absorber overcomes all jars while speed changes are being made. The gears in the speed variator are of the 20-degree pointed type. All bearings are lined with removable bronze bushings.

GENERAL ELECTRIC RIVET HEATER

In an effort to overcome the difficulties involved in heating rivets previous to their being driven and riveted, the General Electric Co., Schenectady, N. Y., has designed an electric rivet heater which is intended to combine the features of simplicity of operation, fool-proofness of construction, and maximum efficiency. This is accomplished in the following design: A transformer rated at 15 kilowatts is mounted on angle-iron legs, which may be fitted with wheels. At the front of the transformer, two copper bars are fitted with heavy air-cooled electrode blocks of cast copper, and under these is another copper block which acts as a support and electrical connection for two rivets in series. When a rivet is stood up on the block and the electrodes are allowed to drop on the head of the rivet, the circuit is completed and heating begins. The two electrodes may be raised independently by two foot pedals, gravity being sufficient to lower the electrodes when the foot is removed. A primary tap switch mounted on the back legs of the machine gives all the variation needed for different lengths and diameters of rivets and for the rate of heating which is desired.

The advantages claimed for this rivet heater are as follows: Higher efficiency in localizing the heat energy in the rivet, resulting in less heat radiation; better heat regulation in proportion to the quantity of rivets used and that energy is used only when heating rivets; cleanliness of operation because no smoke or gases are formed; no time is wasted in starting production; rivets are heated from the inside, giving greater uniformity and better conditions for upsetting; wastage of rivets is reduced to a minimum; the heater is portable and it takes any rivet up to 7/8 by 5 inches without adjustment; only two power lines are required to each



Electric Rivet Heater manufactured by the General Electric Co.

heater; five pounds of rivets are heated per kilowatt hour. The heaters so far developed are a 5-kilowatt two-jaw type for rivets up to 1/2 inch in diameter, and a 15-kilowatt two-jaw type for rivets up to 7/8 inch diameter. The two-jaw heaters are intended for one gang use; however, under actual test the 15-kilowatt machine heated five hundred 1/2- by 1 1/4-inch rivets in one hour, which is ordinarily enough for two gangs of gun riveters.

KREMER-CUMMINS MECHANICAL BELT SHIFTER

The Kremer-Cummins Machine Co., 1831-1833 E. 55th St., Cleveland, Ohio, is now making a mechanical belt shifter which is of extremely simple design and efficient in operation. The operating mechanism of this device comprises a length of structural steel channel having rack teeth formed along one edge. Slidably mounted upon the channel there is a cast iron bracket carrying a gear or sprocket in mesh with the teeth of the channel, and extending from one side of the bracket there is an arm enlarged at its outer end to encircle the machine belt. Any size of belt, from 1 1/2 to 6 inches wide may be shifted, depending only on the size of opening in the arm. Castings are provided at each end of the steel channel for attachment to an iron pipe frame which supports this mechanism close to the overhead countershaft. Extending downward from the gear or sprocket in mesh with the channel member, there is a shaft equipped at its lower end with an operating handle. A length of pipe extends downward from the overhead sliding bracket and carries at its lower extremity a casting having a slot surrounding the machine belt and provided with a handle for traversing the belt. The last mentioned part may be placed very close to the machine cone pulley, minimizing the force required to shift the belt.

Mechanical Belt Shifter built by the Kremer-Cummins Machine Co.

In manipulating this device, the machine operator first shifts the belt to the desired step on the machine cone pulley by moving the handle provided for the purpose. This operation is immediately followed by traversing the upper belt guide along the steel channel member until the belt is running on the desired step of the overhead cone pulley. This second operation is accomplished by means of the conveniently placed handle on the shaft of the operating gear or sprocket. The above mentioned gear or sprocket may be arranged for either right- or left-hand rotation, as desired. The device is strong enough for shifting any ordinary machine belt. The belt guides, the only parts it is necessary to change in adapting this device to various widths of belts, are furnished to the customer's specifications.

It is believed that mechanical belt shifters make for increased efficiency and greater production in the shop, and there are at least five states where the use of permanently attached mechanical belt shifters is required by law. No parts of the belt shifter are applied directly to the machine tool, and the entire work of installation is reduced to a minimum. The operating mechanism is supported on an iron piping frame, and the lower belt guide, with its handle,

is carried by a piece of tubing; the operating handle, by a piece of cold-rolled steel ½ inch in diameter. These two last mentioned pieces, together with the overhead frame, are supplied by the customer. Since it is necessary for him to obtain the measurements from his particular installation of machinery, and being materials which can be readily obtained, it is probable that the customer can secure them himself at the lowest possible price. This reduces the expense and confines the customer's investment to belt shifting mechanism entirely.

ZINC SHEATHING METAL

For use in lining packing cases for export shipment, the Church Appliance Mfg. Co., La Salle, Ill., is now making a product known as zinc metal sheathing, which was used extensively by the United States Government during the war to line munition cases, powder boxes, etc. This zinc metal sheathing consists of thin, pliable sheets of pure zinc, which are very light in weight and easy to handle. It is claimed that this zinc will last as long as copper, and it is the property of this metal not to rust. The sheathing is said to be clean, sanitary, permanent, fire-resisting, verminproof, and weather-proof.

NEW MACHINERY AND TOOLS NOTES

Starting Switch: Electric Controller & Mfg. Co., Cleveland, Ohio. A starting switch for induction motors which is operated by push-buttons. This switch is enclosed in a steel box, and is provided with conduit connections for all wires.

Slotting Attachment: Walsh & Allen, Wilbur Ave., Brooklyn, N. Y. A slotting attachment for use on drilling machines, this attachment being secured to the table. Power is derived from the drilling machine spindle, and an abundant range of speeds is obtainable.

Boiler Tube Expanders: J. Faessler Mfg. Co., Moberly, Mo. Two boiler tube expanders of somewhat different design, although both are intended for the same work, their function being to roll the tube tight into the sheet and flare the end, without removing the tool.

Air Drill: Duntley-Dayton Co., 1416 Michigan Ave., Chicago, Ill. A multiple cylinder air drill equipped with a motor of the rotating cylinder type which has three cylinders. The pistons are of large diameter, and have a short stroke, making them suitable for operation at high speed.

Grinding Machine: Draper & Hall Co., Middletown, Conn. A No. 1 surface grinding machine on which the sliding table has no overhang. The table is supported for its entire length by the longitudinal slide. Grinding wheels 6 inches in diameter by ½ inch face width are used in this machine.

Portable Arc Welding Machine: Ohio Brass Co., Mansfield, Ohio. This machine was designed primarily for application in welding rail bonds, and is intended for use in mines where the space is likely to be quite restricted. It is also found useful as a shop tool because the machine can be easily carried by two men.

Motor-driven Keyseating Machine: Bucher-Smith Co., East Liverpool, Ohio. A motor-driven keyseating machine which is of similar design to the machine of this company's manufacture which was illustrated and described in the November, 1917, number of MACHINERY, except that it is equipped with individual motor drive.

Precision Bench Lathe: Urban Machine & Tool Co., 2424 St. Clair Ave., Cleveland, Ohio. A self-contained precision bench lathe of unusual design. It has a cylindrical body ground to accurate size and provided on the under side with a ground guide bar for guiding the carriage and tailstock. The machine swings 8 inches over the bed.

Stay-bolt Heading Attachment: Liberty Tool Co., Munsey Bldg., Baltimore, Md. A stay-bolt heading attachment for use in railroad and boiler shops for riveting stay-bolts, stay-rods, or countersunk rivets on steam-, oil- or water-tight work. This attachment fits on a standard air "gun" which is commonly used in shops of this character.

Cincinnati Milling Machine: Cincinnati Milling Machine Co., Cincinnati, Ohio. A No. 4 high-power horizontal milling machine made in both plain and universal types. The design of these machines is similar to that of the No. 5 machine of this company's manufacture, which was illustrated and described in the June number of MACHINERY.

Pipe Cutting Machine: Fox Machine Co., Jackson, Mich. This is known as a No. 10 pipe cutter and was designed to meet the demand for increased production in handling such work. The machine operates on the power-driven revolving cutter principle, and the pipe rests on broad rollers. The cutter is brought into contact with the pipe by means of a foot-treadle.

Rivet Heating Furnace: Liberty Tool Co., Munsey Bldg., Baltimore, Md. A self-contained tank and heating torch for use in railroad shops and other plants where the work is of a similar nature. A torch is operated from the tank, with only one line of hose leading to the burner. Compressed air furnished from an outside source is employed to give the required pressure of oil in the burner.

Direct-current Motors: Allis-Chalmers Mfg. Co., Milwaukee, Wis. A line of commutator direct-current motors of rugged and compact design, which are said to possess excellent operating characteristics. As the ratings and speeds of the constant-speed motors are identical with those of the 60-cycle induction motors, they can be used interchangeably without requiring adjustment of the gear ratios.

Toolmaker's Vise: Austin Tool & Machine Co., Inc., Pittsburg, Pa. A bench vise adapted for the use of tool-, instrument-, and model-makers. The body of this vise is designed to withstand heavy strains, and its outline is made square on five sides, which adds to its convenience and eliminates projections that are likely to catch the clothing of men passing the bench, and prove inconvenient in other ways.

Tire Rim Contracting Machine: Charles Grotnes Machine Works, 128 N. Jefferson St., Chicago, Ill. It is a common practice to weld tire rims to a diameter less than the required size and subsequently expand them to the required diameter. A substitute method is made possible by the use of a machine built by this company, by which the rims are welded over size and then contracted to the required diameter.

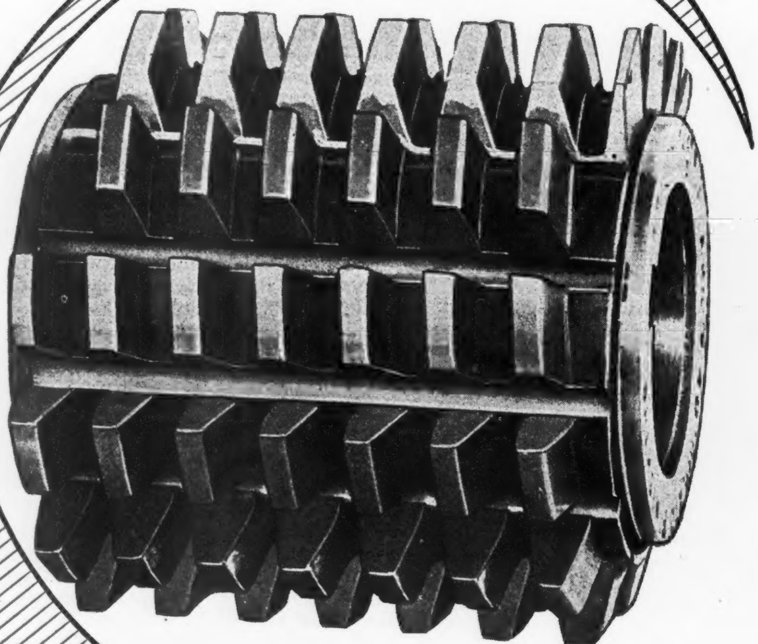
Continuous Milling Machines: Ingersoll Milling Machine Co., Rockford, Ill. Vertical and horizontal milling machines which are adapted for application of the continuous principle of milling in the machining of large castings. With machines of this type there is practically no idle time for either the machines or the operators, because work can be set up and removed while operations are being performed on castings that are passing the cutters.

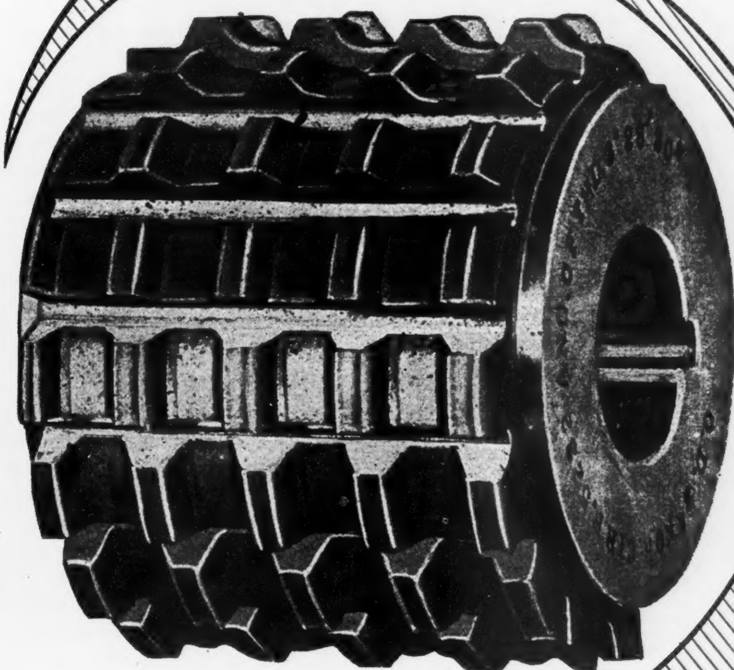
Die-sinking Machine: Riverside Machinery Depot, 17 St. Aubin, Ave., Detroit, Mich. A combination die-sinking, milling, and cherrying machine sold by this firm, for use in machining drop-forging dies. It has a variety of labor-saving features which effect substantial economies in the time of handling work of this kind. Among these, mention is made of the unusually smooth finish imparted by the cutter, and the rapid operation of the machine.

Measuring Machine: Taft-Peirce Mfg. Co., Woonsocket, R. I. A machine for use in making accurate measurements on a commercial scale, which is especially adapted for such operations as checking the dimensions of plug gages and similar tools. Accuracy of measurement by this machine is dependent only upon a measuring bar and measuring screw, and this simplicity of design is said to make it improbable that the machine will get out of adjustment.

Portable Drilling Press: Liberty Tool Co., Munsey Bldg., Baltimore, Md. Two portable drilling and countersinking presses for use in connection with air-drill work. One of these is designed to fit any make or shape of pneumatic drill, and is equipped with a 2¾-inch air cylinder at its base, which provides a pneumatic feed of the work to the tool. The other machine is provided with a double-cylinder air feeding device, which represents still a further development of the same principle of machine design.

Multiple-spindle Drilling Machine: Lima Drill Press Co., Lima, Ohio. A multiple-spindle drilling machine of the magazine type, which embodies some interesting principles in its design. This machine is adapted for use in tool-rooms and other shops where a number of different sized drills, reamers, and countersinks are required. There are sixteen spindles in the magazine, which serves as a tool rack for holding this number of different sizes of tools, either of which can be immediately brought into operating position.





CHECKING JIG AND FIXTURE DRAWINGS

By ROBERT MAWSON

Drawings of jigs, fixtures, and special tools are usually checked before being sent to the shop, and the care with which the checking is done determines to a considerable extent whether or not the tool will be found satisfactory when completed. It is less expensive to make corrections on paper than on machine parts and for this reason all drawings should be carefully checked in order to eliminate the necessity for correcting mistakes in design, either in the pattern shop or tool-room. The checking should be done systematically, as otherwise some error may be overlooked by the checker. In the following, the points which should be checked are first tabulated, after which brief notes on some of the most important points are given.

1. Is lay-out of piece in tool or fixture correct?
2. Is work properly located?
3. Is there sufficient clearance between work and tool?
4. Can work be loaded or unloaded without interference?
5. The design should not permit the work to be inserted in a reversed or inverted position.
6. Whenever possible have the clamping screws inside of a geometrical figure formed by drawing lines connecting the extreme ends of the locating points.
7. Are feet on jig or fixture of sufficient length?
8. Check grinding allowances on piece to be machined.
9. Are all dimensions given which are required in machining the piece?
10. Are seats, stops, clamps, binding screws, bushings, and locating devices properly designed, dimensioned, and located?
11. Can stock parts be used in making the jig or fixture?
12. Are tolerances and decimal dimensions correct?
13. Can fixture be assembled and can piece be put into tool in more ways than one?
14. Do all clamping bolts, especially hook-bolts, clear the piece at all positions?
15. Is it possible to machine all parts?
16. Is method of clamping such that work will not be distorted?
17. Are finish marks shown on all surfaces which are to be machined?
18. Are the projections of all views correct?
19. Do dimensions scale correctly?
20. Is scale size given on drawing?
21. Do the detail dimensions total correctly with the overall dimensions?
22. Are notes and references for grinding correct?
23. Does fixture fit machine and are bolt holes provided for fastening it in place?
24. Do cutting tools interfere?
25. Are cutting tools or bars of sufficient length?
26. Will cutting tools pass through bushings?
27. Do bushings fit tools properly?
28. Is marking pad provided?
29. Is stock and material list complete?
30. Are title, piece, pattern, sheet, tool, and tool sub-numbers given?
31. Are provisions made on milling fixtures for gaging or locating the fixtures in their correct positions on the machine table?

The importance of most of these points will be apparent, but brief notes on some of them may be necessary. Points (1) and (2) should be checked carefully, because if the part to be machined is laid out or located incorrectly, interference may occur between the tool and the fixture. For the same reason points (3) and (4) should be carefully noted. Point (5) must obviously be carefully considered in order to have the fixture fool-proof. If the condition outlined in point (6) does not prevail, the piece is likely to become distorted when the clamps are fastened down.

If the feet on drill jigs (7) are not of sufficent length to prevent any part of the piece or clamping device from touching the machine table, the holes to be machined will not be in the correct position or at the proper angle; hence, the only surfaces which should be allowed to rest on the table are the ends of the feet. The toolmaker needs the correct dimensions for the elements covered in (10) and these should be supplied by the designer. Stock parts should be used whenever possible, as they are cheaper because they can be produced in quantities and the tool can also be built quicker and at less expense. Limits should be given on important dimensions. If the proper tolerances (12) are not expressed the toolmaker is likely to use others that are incorrect. Make sure that the tools are so designed that they can be made. The importance of finish marks (17) to the patternmaker and toolmaker is evident, and these should not be overlooked. The drawings (18) should always be made in the third-angle projection. The importance of providing bolt holes for fixtures (23) is appreciated by anyone who has attempted to fasten a tool on a machine without such mediums. The importance of giving the stock list of materials (29) is well known though sometimes overlooked. Such a list enables a man to get out all the standard parts needed, and their location on the tool drawing should be noted. This will save much time and confusion when assembling the tool.

Point (31) needs a word of explanation. It is good practice to use, wherever possible, some standard size of gaging block, say 3/8 inch or 1/2 inch, and this size should be stamped on the gaging pad that is machined on the fixture. In this way the operator becomes accustomed to a certain size of gage-block, and these can also be made up in quantities to reduce expense. In conclusion, it might be added that if the checker will inspect the drawings with a system such as given, he may be confident that the work is not only done thoroughly, but also that the tools will be made with the greatest satisfaction to all.

* * *

LONG SERVICE RECORD WITH ONE CONCERN

William Smith recently celebrated the fiftieth anniversary of his employment with the Automatic Machine Co., Bridgeport, Conn., at practically the same time as he celebrated his eightieth birthday. Mr. Smith was born in Scotland, and at the age of twelve years went to England to learn the machinist's trade and came to the United States when he was thirty years old. At that time he entered the employ of the Pacific Iron Works, which plant was absorbed in 1908 by the Automatic Machine Co., and he has been working continuously for fifty years for the same employer. On the occasion of the fiftieth anniversary of his employment with the concern and his eightieth birthday, he was given a luncheon by the Foremen's Club of the Automatic Machine Co. to celebrate the dual anniversary and was also presented with a purse of gold. It is stated that Mr. Smith is just as good a mechanic as he ever was; in spite of his age, he is on the job every day, running his lathe, and is well preserved physically with a keen alert mind.

* * *

INTERNATIONAL TRADE CONFERENCE

The International Trade Conference held at Atlantic City, beginning Wednesday, October 22, was attended by business men from the leading nations in the world, foreign visiting missions from Great Britain, France, Italy, and Belgium being present. The conference was called by the Chamber of Commerce of the United States with the object of laying before the business men of this country the commercial needs and aspirations of the foreign nations represented. Following a five-day conference, the foreign delegates toured the important industrial centers of the United States and were enabled to inspect industries of interest to them, to form business acquaintances with American business men, and to gain a comprehensive idea of American methods.

THE POSTAL ZONE LAW

By SENATOR ARTHUR CAPPER, of Kansas

It has been argued that the postal zone increases apply only to the advertising sections of magazines. This is perfectly true as a statement of the mere words of the postal zone law. It is not true as a statement of facts. For a periodical or a newspaper is a unit from cover to cover. It is one unit of bulk that is never broken. The argument that the increased postage merely affects advertising is virtually the same as if it were argued that the postal zone legislation had provided that the upper half of a magazine should pay postal zone rates and the lower half flat rates. It would be a mere bookkeeping separation *that would not in the least affect the postage cost to the reader,* for the reader—who is the ultimate consumer—takes the magazine as it comes, and the cost of the magazine is its cost *as a unit,* and its postage cost to him is its entire cost as a unit, no matter how ingeniously or intricately one may subdivide the component parts.

Advertising is the one great factor in modern wealth production that enables wealth to be distributed almost instantaneously; a generation or so ago the same result could not have been accomplished without years of hand-to-hand selling, and expensive, slow, personal salesmanship. Congress itself saw this, and when means of war taxation were being carefully discussed and every channel was being developed, it was deliberately decided that the destructive economic effects that would follow the taxation of advertising would be too great and too dangerous to attempt.

Now then, as to the allegations of the cost of transmission of this second-class matter through the mails. The figures upon which the absurd allegations of second-class deficits are made were compiled by the Post Office Department in 1908 and 1909—eleven years ago! So unreliable were they even then that, when the U. S. Postal Commission, headed by the Hon. Charles E. Hughes, investigated them two years after their compilation, they were officially discredited as being no indication of what the costs were for the various divisions of second-class matter! Moreover, the Post Office Department since that date has taken pride in stating that it has in enormous and basic ways cheapened the postal cost of second-class matter.

The most unfortunate part of this postal zone legislation is that it is an insidious and dangerous attempt to set back postal history seventy years and re-establish the universally condemned principle of postal cost determining the postal rates. It abolishes the sound postal principle of equal postage to all parts of our nation. The rural free delivery—one of the most vital and important postal functions—is conducted at almost a total loss, and if this vicious and unsound cost principle is once established, the demoralization of our splendid postal principles is only a matter of logic and time.

* * *

ERICSSON-DeLAMATER MEMORIAL MEETING

The American Society of Mechanical Engineers, in conjunction with a number of technical societies and civic organizations will hold a memorial meeting at 8 o'clock on the evening of December 3, at the Engineering Societies' Building, 29 W. 39th St., New York City, to commemorate the work of John Ericsson and Cornelius H. DeLamater, whose contributions to the progress of naval architecture and industrial engineering are well known to every engineer. It is suggested that those who possess prints or documents relating to the work of these two men, or to the Phoenix Foundry which stood on West St., between Vestry and Laight St., from 1838 to 1851, and the DeLamater Iron Works located at the foot of W. 13th St., from 1851 to 1889, would confer a favor upon the committee for the commemoration by communicating with the chairman of the committee, H. F. J. Porter, American Society of Mechanical Engineers, 29 W. 39th St., New York City, with the view of possibly lending such documents as they may have in their possession to the society for the duration of the memorial meeting.

* * *

An investigation undertaken for the purpose of determining whether magnetic analysis is practicable for detecting flaws in rifle barrel steel, showed that this method is amply sensitive for detecting and locating flaws. A large number of bars were examined for magnetic uniformity along their whole length by means of a special apparatus. In spite of the fact that these bars were taken from material which had previously been rejected as a result of drilling tests, not one was found which contained a pipe. Further investigation is necessary to determine to what degree the sensitiveness of the apparatus should be reduced in order not to cause the rejection of material which is suitable for all practical purposes, and also to determine the kind and magnitude of the effect which will be produced by a pipe. This experimental work is being carried on at the plant of the Winchester Repeating Arms Co.

PERSONALS

O. H. Root, former acting secretary of the Kelly Reamer Co., Cleveland, Ohio, has resigned his position, and George H. Moore has been made assistant secretary.

C. W. Cross has been appointed by the Chicago Pneumatic Tool Co. manager of western railroad sales, with headquarters in the Fisher Building, Chicago, Ill.

Harry T. Calkins has joined the sales force of the Tacony Steel Co., Philadelphia, Pa. Mr. Calkins will be connected with the New York office, but will sell in Connecticut exclusively.

Sergeant Edward W. Keefer, who was formerly eastern traveling representative of the Bearings Co. of America, Lancaster, Pa., has returned to his former position with the company.

E. W. Thompson, who for the last eleven years has represented the Standard Tool Co. in Illinois, will take charge of the sales of the Davidson Tool Mfg. Corporation in Illinois, his headquarters being located in Chicago.

V. B. Taylor, for some time connected with the general sales department of the Lyon Metallic Mfg. Co., Aurora, Ill., has been appointed manager of the Pittsburgh district sales office, having offices in the Oliver Building.

William E. Kelly, president and general manager of the Kelly Reamer Co., Cleveland, Ohio, has retired from active management of the company's affairs, and his duties have been turned over to J. M. Davie, assistant general manager.

George Roemer Woods, who recently resigned from the Allied Machinery Co. of America, has been appointed manager of the New York office of R. S. Stokvis & Zonen Ltd., of Rotterdam, Holland, which is located at 17 Battery Place, New York City.

G. E. Anderson, formerly assistant to the vice-president of the American Locomotive Co., has been appointed assistant eastern sales manager of the Duff Mfg. Co., with headquarters at the eastern sales office, 50 Church St., New York.

Oscar W. Miess has been appointed production engineer with the United Shoe Machinery Co. of Canada, Ltd., Montreal, Canada. Before going overseas with the Sixth United States Engineers, he was in charge of tool designing and construction with this concern.

George W. Snyder, who for several years has represented the Haynes Stellite Co. in western Ohio, has been made sales engineer with the Davidson Tool Mfg. Corporation, New York, representing the company in western Ohio and Indiana. His office will be located in Cincinnati.

O. P. Wilson, for several years assistant general manager of the Norma Co. of America, New York City, was elected vice-president of the company at a recent meeting of the directors. W. M. Nones will continue as president and treasurer in executive charge of the company's affairs.

J. W. Badgley has recently been appointed Cleveland representative of the Erie Crucible Steel Co., Erie, Pa. Mr. Badgley was first lieutenant with the 90th Division of the U. S. Army, and served for a year and a half in France. Prior to entering the service, he was connected with the Sherwin-Williams Co.

L. F. Tankard, who has recently returned from overseas, has associated himself with Messrs. MacNutt and Watts in a general electrical engineering and contracting business under the firm name of MacNutt, Watts & Tankard, Inc., having offices, stock-room, and general repair shops at 9 Great Jones St., New York City.

William Ford Upson has been appointed Trade Commissioner to Vienna, by the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C. As soon as circumstances permit, he will proceed to his post to conduct an investigation of general commercial and economic conditions in Austria and Serbia.

Joseph H. Hazley, who has been sales engineer and service man in charge of the eastern territory for the Wilmarth & Morman Co., Grand Rapids, Mich., for the last eight years, has become associated with the Jacobs Mfg. Co., Hartford, Conn., manufacturer of chucks, and the Rhodes Mfg. Co. of Hartford, manufacturer of shapers.

Edward R. Abbott has joined the sales force of H. W. Cotton, Inc., Brooklyn, N. Y. He will have charge of the western business, making his headquarters for the present in the Woolworth Building, New York City, and later at Cleveland, Ohio. Mr. Abbott was formerly a member of the sales force of the Taft-Peirce Mfg. Co. in the New York office.

E. G. Buckwell, secretary and manager of sales of the Cleveland Twist Drill Co., Cleveland, Ohio, has recently returned from a three months' visit to England and the Continent, where he has made a thorough trade investigation in conjunction with the European branch of the company.

C. H. Champion, who has been traveling through England, France, and Italy on behalf of Champion & Ryan, Inc., New York City, importers and exporters, returned to America October 1. Mr. Champion is bringing with him full specifications and particulars of electrical and mechanical supplies and specialties required for the foreign markets in the countries which he has visited, for the purpose of communicating the information to American manufacturers.

A. G. Gibbons, formerly superintendent of tools and supplies of Winslow Bros. Co., Chicago, Ill., has become affiliated with the Wetmore Reamer Co., 210 Sycamore St., Milwaukee, Wis., in the capacity of production engineer. Mr. Gibbons was also employed by the Cadillac Motor Car Co. and the Brown & Sharpe Mfg. Co. for many years. The Wetmore plant has been rearranged and additional equipment has been installed under Mr. Gibbons' direction, which has considerably increased the production of Wetmore expanding reamers.

B. M. W. Hanson has established an engineering bureau at 570 Park St., Hartford, Conn., and is in a position to place his experience in the designing, building, and marketing of machinery at the service of the manufacturing industries. Mr. Hanson is well known throughout the machine building field in the United States, having for many years been the general manager of the Pratt & Whitney Co., Hartford, Conn., and more recently having held the same position with the Colt's Patent Firearms Mfg. Co., Hartford, Conn.

Earl E. Eby, sales manager for the Hyatt Roller Bearing Co., Industrial Bearings Division, Metropolitan Tower, New York City, has been appointed a member of the board of directors of Hyatt, Ltd., a new company which has been formed to market the Hyatt roller bearing in Europe. Mr. Eby will devote his entire time to this work, and his headquarters will be in New York City. G. O. Helmstaedter, formerly Chicago district manager, has been promoted to the position of sales manager to take the place of Mr. Eby.

Albert H. Mitchel, formerly with the Taft-Peirce Mfg. Co. of Woonsocket, R. I., has become associated with H. W. Cotton, Inc., Brooklyn, N. Y., as vice-president and general sales manager, with headquarters in the New York office in the Woolworth Building. For nine years Mr. Mitchel was in the engineering department of the Taft-Peirce Mfg. Co. at Woonsocket, after which he entered the sales department as Chicago representative. For the last five years he has been in the New York office as district sales manager. H. W. Cotton, Inc., designs and builds jigs, tools, and special machines, and also manufactures parts or complete machines on a contract basis.

Harry W. Waterfall has been appointed assistant professor of mechanical engineering at the College of Engineering of the University of Illinois, Urbana, Ill. Mr. Waterfall is a graduate of the Massachusetts Institute of Technology. He was assistant in mechanical engineering at the Massachusetts Institute of Technology from 1911 to 1912 and was assistant to the chief engineer of William Cramp & Sons Shipbuilding Co., Philadelphia, Pa., from 1912 to 1913. From 1913 to 1917, he was instructor in machine design at the University of Illinois, and for the last two years has served as mechanical engineer of the Angus Co., Calcutta, India.

Alfred LaMar, assistant director of sales of the United States Government, has returned to Washington from Europe and resumed his duties in the office of the Director of Sales, Washington, D. C. Mr. LaMar will have the immediate supervision of sales of surplus war materials made for export, and will direct the activities of the machine tool section of the office of the Director of Sales. Mr. LaMar went to Europe early in April to survey European markets. He arranged the details of a visit recently made to the United States by a commission from Belgium, which came to this country under the auspices of the Belgian Government with a view to purchasing government-owned machine tools. He also organized the machine tool section of the office of the Director of Sales shortly after the establishment of that office by the Secretary of War.

OBITUARIES

W. P. Sparks, who has been representative for the past year of the Cleveland Milling Machine Co. at Indianapolis, Ind., died October 10. Mr. Sparks was held in high esteem by the members of the firm and by the trade in general.

H. W. Andrews, president of the Andrews & George Co., Tokyo, Japan, importers of machine tools for the Empire of Japan, died at his residence in Yokohama, August 16, aged seventy-four years. Mr. Andrews was Ambassador to China under the administration of President Harrison. After his term expired, he returned to his native home in Cincinnati, Ohio, where he remained about a year, after which he returned to Yokohama, Japan, forming a partnership with Mr. George which has continued unbroken until the present time. The firm will continue as heretofore, his son, R. M. Andrews, succeeding him in the business.

PETER KETTENRING

Peter Kettenring, founder and president of the Defiance Machine Works, Defiance, Ohio, died at his home in Defiance October 8, aged eighty-three years. He was born in Rheinpfalz, near the city of Strassburg, on January 6, 1836, and when he was three months old his family moved to America, settling in Defiance—then a village of 150 inhabitants—when he was eight years of age. Mr. Kettenring, through the subsequent establishment of the Defiance Machine Works, has been a potent factor in the development of the city. He started work as a molder in a little shop on the corner of Ferry and Third Sts., the site of the present office building of the organization which he founded and of which he was president up to the time of his death. At the age of twenty he became one of the owners of the foundry, from which he developed the present business. Thirty years ago, Mr. Kettenring's three sons, who had been carefully trained in different departments of the business, became a part of the organization. The oldest son died in 1915, but the other two sons are still actively associated with the business. He is survived by four children.

COMING EVENTS

December 1-4—Fourth New York State Safety Congress at Syracuse, N. Y.; headquarters, Hotel Onondaga. Secretary, Edward W. Buckley, State Industrial Commission, Albany, N. Y.

December 2-5—Annual convention of the American Society of Mechanical Engineers at the Engineering Societies Building, 29 W. 39th St., New York City. Secretary, Calvin W. Rice, 29 W. 39th St., New York.

January 6-8, 1920—Annual meeting of the Society of Automotive Engineers, Inc., in New York City, at the Engineering Societies Building, 29 W. 39th St.

February 2-6, 1920—First annual mechanical inspection equipment exposition and convention of the American Society of Mechanical Inspectors at the Hotel Astor, New York City. Secretary, Henry F. Winter, 35 W. 39th St., New York City.

May 15-20, 1920—Seventh national foreign trade convention in San Francisco, Cal. Secretary of the National Foreign Trade Council, O. K. Davis, 1 Hanover Square, New York City.

BOOKS AND PAMPHLETS

1919 Year Book of the Merchants' Association of New York.—306 pages, 7 by 10 inches. Published by the Merchants' Association of New York, 233 Broadway, New York City.

History of the War Activities of the Merchants' Association of New York.—48 pages, 6 by 9 inches. Published by the Merchants' Association of New York, 233 Broadway, New York City.

Protective Metallic Coatings for the Rustproofing of Iron and Steel.—34 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 80 of the Bureau of Standards. Price, 10 cents.

Location of Flaws in Rifle-Barrel Steel by Magnetic Analysis.—By R. L. Sanford and William B. Kowenhoven. 10 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 343 of the Bureau of Standards. Price, 5 cents.

Lubrication of the Motor Car Chassis.—Chart arranged by Victor W. Page. 24 by 38 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, 35 cents.

This chart presents a plan view of a typical six-cylinder chassis of standard design, outlining all the important bearing points requiring lubrication, and gives instructions for the proper method of lubricating.

Five Hundred Business Books.—Compiled by Ethel Cleland, librarian of the business branch of the Indianapolis Public Library. 72 pages, 6 by 9 inches. Published by the American Library Association, Library War Service, Washington, D. C. Distributed free of charge.

This pamphlet contains a list of business books covering general business, commerce, finance, bookkeeping and accounting, factory organization and management, and other subjects. The names of the publishers, prices, and brief annotations giving an idea of the contents are included.

An Export Order and Allied Topics.—Published by the National Association of Manufacturers, 30 Church St., New York City.

In view of the large number of requests received from manufacturers for copies of this booklet, the National Association of Manufacturers has published a second edition, of which copies will be forwarded upon request to all who are interested in foreign trade. The booklet shows clearly the successive steps involved in the handling of an export order, and explains in a simple manner the methods used. The actual documents, forms, correspondence, and other papers employed in the filling of the order are reproduced and the function of each is explained in a very definite manner.

Operations of the Federal Trade Commission.—Prepared for the National Association of Manufacturers by the Law Department of the association. Published by the secretary of the National Association of Manufacturers, 30 Church St., N. Y. City.

The operations of the Federal Trade Commission have become a study of great importance to business men of the United States. The commission is charged with the administration of the Federal Trade Commission act and with provisions of the Clayton act, and from time to time with investigatory functions and duties that reach into every commercial activity of industry. No attempt has heretofore been made to compile and analyze the decisions of the commission for the purpose of obtaining through them the commission's own viewpoint of the meaning and application of the important statutory duties with which it is charged. The present study is intended to provide the manufacturer with a reference volume which will enable him to understand, through the commission's acts, its own perception of its function.

Techno-Chemical Receipt Book.—By William T. Brannt and William H. Wahl. 495 pages, 5¼ by 7¼ inches; 78 illustrations. Published by Henry Carey Baird & Co., Inc., 116 Nassau St., New York City. Price, $2.50.

This is a revised and enlarged edition of a book containing a large number of approved receipts for use in the arts, the industries, and the household, most of which have been thoroughly tested before being presented to the public. Numerous receipts have been added in the new edition. The book is encyclopedic in form, and the alphabetical arrangement, together

with a comprehensive table of contents, covering twenty-nine pages, and a detailed index, make reference to any subject or special receipt prompt and easy. Simple language has been employed so that the receipts and processes will be intelligible to the non-technical user. Mention of a few of the subjects covered will serve to give an idea of the wide scope of the book: Alloys; bleaching; boiler incrustations; building materials; cleansing, polishing, and renovating agents; copying and printing; decoration, ornamentation, etc.; dyeing; food preparation; glass; household and rural economy; metal industry; manufacture of paper; pharmaceutical preparations; photography; soldering and solders; bookbinding.

Governors and the Governing of Prime Movers.—By W. Trinks, professor of mechanical engineering, Carnegie Institute of Technology, Pittsburgh, Pa. 236 pages, 6 by 9 inches. 140 illustrations. Published by the D. Van Nostrand Co., 25 Park Place, New York City. Price, $3.50, net.

The knowledge of governors and governing among both designing and operating engineers is often incomplete, due to the fact that this subject does not cover a wide enough field to warrant a separate course in engineering schools, and little comprehensive material dealing with it has been published. The aim of the author of the present book is to fill this gap in technical literature. It is not claimed that the book covers the whole subject of the governing of prime movers, as this would be impracticable for a number of reasons. However, essentials and principles are presented, and the mathematical treatment is such as to be mastered by undergraduates. The illustrations have been drawn especially for this book with the idea of showing diagrammatically essential principles and omitting all else. A bibliography is included to assist the student if he desires to do supplementary reading. The book is divided into fifteen chapters headed as follows: General Statements; The Direct Control Governor as a Motor; The Centrifugal Governor as a Measuring Instrument (Speed Counter); Promptness and Traversing Time; Adjustment of Equilibrium Speed; Shaft Governors; Natural Period of Vibration of Governors; Effects of Outside Forces Impressed upon Governors; Interaction between Governor and Prime Mover; Discarded Types of Speed Governors; Rate-of-flow Governors; Pressure Governors; Relay Governing; Governor Troubles and their Remedies; Self-regulating Features of Prime Movers.

Practical Mathematics for Home Study.—By Claude I. Palmer. 493 pages, 5 by 8 inches; 299 illustrations. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $3.

The author of this book has taught classes in practical mathematics in the evening school at the Armour Institute of Technology for the past fifteen years, and is now associate professor of mathematics at this institution. During this period he has had an opportunity to study the needs of men engaged in various practical pursuits, and the results of this experience have been brought together in the present volume which gives the essentials of arithmetic, geometry, algebra, and trigonometry. Many of the examples given are adapted from engineering trade journals and from handbooks of various kinds, while others are from the author's own experience. A great many of the problems are also practical questions proposed by the students in the classes taught by the author. The scope of the book is best indicated by some of the chapter headings: Common Fractions; Decimal Fractions; Short Methods and Checks; Weights and Measures; Percentage and Application; Ratio and Proportion; Density and Specific Gravity; Power and Roots; Plane Surface—Lines and Angles; Triangles; Circles; Graphical Methods; Prisms; Cylinders; Pyramids; Cones, and Frustums; The Sphere; Various Other Solids; Notation and Definitions; Formulas and Translations; Positive and Negative Numbers; Equations and Formulas; Exponents, Powers and Roots; Quadratic Equations; Variation; Graphics; Logarithms; Angles; Trigonometric Functions; Right Triangles; Relations between Ratios and Plotting; Trigonometric Ratios of More than One Angle; Solution of Oblique Triangles.

Foundry Practice.—By R. H. Palmer. 390 pages, 5½ by 8¼ inches; 217 illustrations. Published by John Wiley & Sons, Inc., New York City. Price, $3.

This is the second edition of the author's text-book for molders, students, and apprentices, partly rewritten and enlarged. The author was formerly instructor in foundry practice at the Worcester Polytechnic Institute, and has had practical experience as molder, foreman, and superintendent of foundries; hence, he has recorded in this work his actual practical experience. The additional information given in the second edition is as follows: "Propeller Casting is Essential to Our Defense," giving a description of the rigging, flasks, molding, securing and pouring the mold to produce large propeller wheels economically. "Casting Locomotive Superheater Cylinders." "Casting Locomotive Slide-valve Cylinders," describing the patterns, flasks, cores, molding, setting and securing cores, gating and pouring, analysis of iron, transverse strength, and deflection. "Casting Lathe Beds and Chilling the Ways," describing the pattern, flasks, molding, arrangement of chills, and resulting benefits. "Making Cores for Gasoline Engine and Automobile Cylinders," showing some of the causes of defects in castings. "Molding Large Kettles, used by Manufacturers of Chemicals, Dyestuffs, etc.," showing different methods of producing them, flasks, and special rigging to produce some styles in large quantities economically. The author has endeavored to prepare a text-book for the student, apprentice, and molder, rather than a reference work for the trained foundryman.

Time Studies as a Basis for Rate Setting.—By Dwight V. Merrick. 366 pages, 6½ by 9¼ inches; 137 illustrations. Published by The Engineering Magazine Co., New York City. Price, $6.

The purpose in preparing this book for rate setting has been to place on record definite information relating to this phase of industrial management, and to lay down the principles covering time study for rate setting, to show the numerous methods that have been helpful in taking observations, and to present some details of practice, particularly in regard to the human relationship involved in the work. The volume is divided into three sections; the first presents the principal methods and implements of time study; the second is an illustration of time study as applied to a line of machine tools, together with a series of tables giving the detail times as established by study; while the final section, in the form of appendices, includes detailed times for a number of other kinds of work, and shows the wide adaptation of the principles and methods outlined. The general scope of the work is best set forth by a review of the chapter headings: Objects and Principles of Time Study; Taking an Operation Time Study; Taking a Production Study to Check Tasks; Production-time Studies on Automatic Machines; Establishing Delay Allowances for Rate Setting; Production-time Study on Variable Operations; Time Studies for Rate Setting on Machine Tools; Preparing Boring Mills to Receive Work; Landing Work, and Operations Preparatory to Machining; Setting Tools and Manipulating Boring Mill to Start Cuts; Machining, Loosening Jaws, and Removal of Work; Developing a Rate from Fundamental Operation Tables; Organizing a Time-study Department; Classification of Time-study Data; Instruction Cards; Rate Tables—Instruction Cards in Tabular Form; Investigations of Molding Processes; Rating for Drop-forging Operations; Investigating a Brass Rolling Mill Process; A unique Control of Variable Tasks; Rating Tasks by Taxing Waste; Rating Sawing-off Metal Stock; Rating Operations on an Automatic Dovetail Jointer; Wage Payment Systems. Being exceedingly detailed in character, the book should appeal to men who are actually engaged in time study and rate setting work, because it will answer the detailed questions which such men would ask.

NEW CATALOGUES AND CIRCULARS

Alexander Milburn Co., Baltimore, Md. Circular of Milburn oxy-acetylene welding and cutting apparatus.

Taylor Instrument Companies, Rochester, N. Y. Circular advertising temperature indicating, recording, and controlling instruments.

Warner Elevator Mfg. Co., Cincinnati, Ohio. Bulletin descriptive of Warner traction engines, motors and controllers for elevator service, and elevator cars.

Electric Controller & Mfg. Co., Cleveland, Ohio. Circular listing the principal features of the alternating-current starting switches made by the company.

Sprague Electric Works of General Electric Co., 527 W. 34th St., New York City. Bulletin 47942, giving specifications for "safety" panel boards and cabinets.

Gisholt Machine Co., 9 S. Baldwin St., Madison, Wis. Circular containing data on solid-adjustable shell reamers, hand reamers, and taper shank chucking reamers.

Victor R. Browning & Co., 17701 Lake Shore Blvd., Cleveland, Ohio. Bulletin descriptive of Browning electric hoists, which have capacities of from one-half to twelve tons.

Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating Ingersoll differential and drum type continuous milling machines in operation milling motor cylinder castings.

Davis-Bournonville Co., Jersey City, N. J. Circular illustrating and describing the Davis-Bournonville decarbonizing outfit for burning out carbon deposits in gas engine cylinders.

Scovill Mfg. Co., Waterbury, Conn. Pamphlet containing the fourth annual report of the industrial hospital maintained by the company for the treatment of sick and injured employes.

Davis-Bournonville Co., Jersey City, N. J. Circular descriptive of cabinet trucks, large-wheel open trucks, and small-wheel open trucks for oxy-acetylene portable welding and cutting outfits.

National-Acme Co., Cleveland, Ohio. Calendar for 1920, containing on the sheet for each month illustrations of National-Acme automatic screw machines, screw machine products, taps and dies, etc.

Knief & Co., 4168 W. 25th St., Chicago, Ill. Circular entitled "Short-cut Calculations Solved by the Slide-rule," advertising slide-rules, folding pocket rules, and combination calipers made by this company.

Lowenstein Radio Co., Inc., 397 Bridge St., Brooklyn, N. Y. Circular descriptive of the universal tapping machine made by this company, which combines the features of a horizontal and a vertical machine.

Manufacturers' Hardware Corporation, Milwaukee Wis. Circular illustrating and describing the Beeman's "time-saver" self-oiling lathe and grinder centers which insure lubrication of the work as it revolves on the center.

Pangborn Corporation, Hagerstown, Md. Catalogue of sand-blast and allied equipment, containing illustrations of the Pangborn organization and interior views of the plant, as well as views of sand-blast installations.

R. D. Nuttall Co., Pittsburgh, Pa. Bulletin 25, on the heat-treatment of steel gears for industrial mining and electric railway purposes. Bulletin 26, on the application and use of the helical type of gearing for electric railway service.

Detroit Reamer & Tool Co., Detroit, Mich., has just issued a new catalogue, 140 pages, 4¾ by 7¼ inches, containing illustrations, prices, sizes and other data relating to the line of cutters and reamers manufactured by this concern.

New Departure Mfg. Co., Bristol, Conn. Circulars 118 FE, 119 FE, 120 FE, and 121 FE, descriptive of the application of ball bearings to gasoline power ice saws, spinning lathe headstocks, special routing machines, and lawn mowers.

School of Mines and Metallurgy of the University of Missouri, Rolla, Mo. Bulletin containing a bibliography on the roasting, leaching, smelting, and electrometallurgy of zinc, compiled by Harold L. Wheeler, librarian of the university.

Cogsdill Mfg. Co., Detroit, Mich. Folder illustrating and describing the "Cogsdrill" combination center drill and reamer—a ground tool made from high-speed steel, having radial relief cutting edges for drilling true and smooth center holes at high speed.

Oliver Instrument Co., Adrian, Mich. Pamphlet entitled "More Accurate Dies and Templets at a Greatly Reduced Cost," describing the method of making dies employed by this company, and illustrating the Oliver sawing, filing, and lapping machines for use in die-making.

L. V. Estes, Inc., 202 S. State St., Chicago, Ill. Booklet entitled "Human Relations in Industry," containing a brief discussion of the underlying principles of personal relations and industrial management that are essential to industrial harmony and maximum production.

Smalley-General Co., Inc., Bay City, Mich. Catalogue illustrating and describing the Smalley-General No. 1 flange thread miller, which comprises the company's regular No. 1 thread milling machine equipped with attachments that adapt it for milling threads on pipe flanges.

Stow Mfg. Co., Inc., Binghamton, N. Y. Bulletins 103 and 104, illustrating the line of portable motor-driven tools made by the company, which includes electric drills, grinders, screwdrivers, radial flexible boring machines, etc., as well as flexible shafting for use with these tools.

Esterline Co., Indianapolis, Ind. Booklet entitled "Typical Graphic Record," illustrating and describing the Esterline graphic recording instruments, and showing examples of records, or curves, which have been made on these machines in a large number of different plants and under varying conditions.

Delphie Specialty Mfg. Co., Detroit, Mich. Folder illustrating and describing the Delphie jack truck, intended for moving heavily-loaded barrels in factories. With this truck, the barrel need not be lifted onto the truck, but it can be approached from any side, and is then jacked up by the truck and moved as required.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Four-page folder entitled "Cutler-Hammer Drum Controllers," describing the special features of these controllers, among which are mentioned accessibility, interchangeability of parts, and interchangeability of methods of manipulation. Dimensions, ratings, and other engineering data are given.

Abrasive Co., Philadelphia, Pa. Booklet describing abrasive grinding wheels for the foundry. The terms grain and grade as applied to grinding wheels are explained and tables are given covering abrasive grade list, the selection of the proper grain and grade for wheels for foundry use, grinding wheel speeds, and price lists for straight and taper-side wheels, and rubber wheels.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Booklet J, illustrating and describing C-H rectangular magnets, which are primarily adapted for handling regular shapes in steel and iron. The booklet shows applications of rectangular magnets for handling ship plates, pipe, cold-rolled steel in coils, and other material. The construction of the magnet is described, and dimensions, lifting capacities, and other engineering data are given.

American Malleable Castings Association, 1900 Euclid Bldg., Cleveland, Ohio. Pamphlet entitled "Malleable Iron, Its Properties and Its Uses," containing an illustrated article on malleable iron, indicating briefly a few of the principles on which the process is based, and pointing out the results that have been obtained through its use. The booklet also describes the work of the association relating to the testing and analyzing of malleable iron castings.

Electric Furnace Co., Alliance, Ohio. Booklet 7-B, descriptive of the company's standard 105-kilowatt tilting electric furnaces for melting brass. Booklet 13-B, containing a reprint of a paper by T. F. Bailey delivered at the Boston meeting of the American Institute of Chemical Engineers, discussing the various electric non-ferrous metal melting furnaces. Bulletin 17-B, descriptive of a special furnace for rolling mills, which is designed for pouring the metal directly into the molds.

Chain Products Co., Cleveland, Ohio. Catalogue C 30 entitled "Weldless Wire Chains." 111 pages, 8½ by 11 inches. The book is divided into three sections, dealing with coil chain, chain specialties, and miscellaneous attachments, respectively, and contains a complete index. Each size of chain is listed separately, giving the dimensions, prices, weight, strength, etc. The margins of the pages are embellished with a series of drawings, suggesting the many uses for which chains of this kind are adapted.

Worcester Pressed Metal Co., Worcester, Mass. Bulletin entitled "The Possibilities of Pressed Metal Engineering," containing illustrations showing actual examples of pressed metal work which has been done by the company for its customers. The examples are typical of what can be accomplished by this process, and include medium seamless drawn shapes, seamless drawn ferrules, tapered drawn shapes, small seamless drawn shapes, irregular seamless drawn shapes, forming and bending, and redevelopment in pressed metal.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular descriptive of the Cleveland system of making punches and dies, which, through the use of standard coupling nuts and sleeves, enables any size hole ranging from ¼ inch to 1 1/16 inches to be punched with the same nut and punch stem. By

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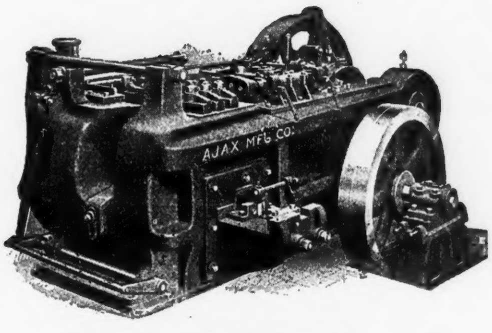
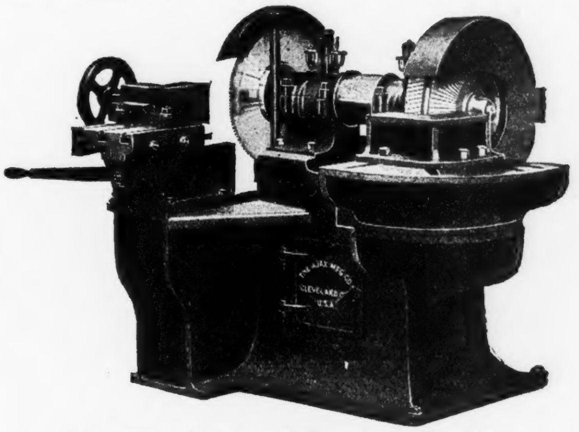
(Trade Mark Registered)

Machines That Reduce Forge Shop Costs



Ajax Steel Bed Upsetting and Forging Machine

An indispensable machine for the Forge Plant, for the production of all kinds of car and locomotive forgings, giving maximum production and minimum maintenance cost.



Ajax Hot Saw and Burring Machine

These tools are rapidly developing to be a very essential part of the forge shop equipment for economical production in connection with Upsetting Forging Machines. Finished forgings are sawed from the hot bar and the flash is hot milled or the stock can be prepared preparatory to upsetting.

Ajax Machines like these are saving thousands of dollars yearly in the forge shops of leading railroads here and abroad.

Over two-thirds of the forging machines in the world are Ajax-made.

Their value for rapid production of forgings of all kinds has been definitely proven by years of hard practical service.

There is an Ajax Machine which exactly suits *your* forge shop problems. Send us samples or blue prints and we will give you detailed figures on how much an Ajax Machine will save you.

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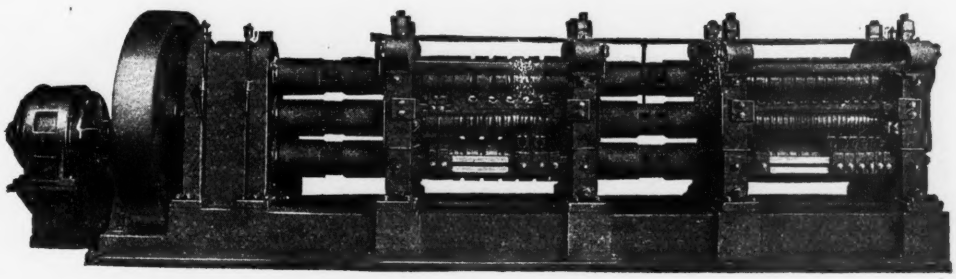

Reclaiming Rolls

By re-rolling scrap pieces of iron and steel bars to form good stock of smaller size, rolls of this type are saving railroad companies and large factories many thousand dollars yearly.

Makers of

Automatic Feed Rivet and Bolt Headers, Hand Feed Rivet and Bolt Headers, Continuous Motion Heading Machines, Bulldozers, (High Speed and Standard), Hot Sawing and Burring Machines, Axle Upsetting Machines, Reclaiming Rolls, Universal Forging Machines, Hot Pressed Nut Machines, Taper Forging Rolls.

using another nut on the same stem, the range can be increased up to 1 5/16 inches, which is sufficient for all ordinary punching. The same arrangement is followed for larger sized holes punched on the heaviest machines.

Du Pont Chemical Co., Wilmington, Del. Pamphlet listing second-hand machinery and equipment which is offered for sale owing to the closing of the Du Pont war plants. The classes of machinery listed are builders', contractors', and plumbers' equipment and supplies; general manufacturing equipment; machine shop and foundry equipment; power plant equipment; hauling and transportation equipment; office equipment; welfare and hospital equipment and supplies; and miscellaneous equipment. A copy of the booklet will be sent upon request.

Wood Turret Machine Co., Brazil, Ind. Catalogue 12, describing the complete line of "Tilted Turret" screw machines, turret lathes, brass-working machines, and extra-capacity automatic chucking turret lathes. Illustrations of various types of screw machines and turret lathes are shown, as well as views showing the details of construction, and specifications are given. Several pages are devoted to improvements and special construction. Considerable space has been given to the tooling equipment and various special fixtures that can be furnished with or applied to a "Tilted Turret" machine.

Allied Machinery Co. of America, 51 Chambers St., New York City. Catalogue of metal-working machinery, showing the turning machines manufactured by the South Bend Lathe Works, of South Bend, Ind.; turret machines manufactured by the Warner & Swasey Co., Cleveland, Ohio; milling machines manufactured by Gooley & Edlund, Inc., Cortland, N. Y.; milling machines manufactured by the Chicago Machine Tool Co., Chicago, Ill.; gear-cutting machines manufactured by Gould & Eberhardt, Newark, N. J.; and brass-working machines manufactured by the Warner & Swasey Co., Cleveland, Ohio.

J. H. Williams & Co., 61 Richards St., Brooklyn, N. Y., makers of "Superior" drop-forgings and drop-forged tools, have just issued a catalogue, 160 pages, 4 by 6 inches, fully illustrating and describing their standard stock specialties. These include several lines of new tools, among which are "Agrippa" set-screw pattern turning-tool holders, "Agrippa" boring-tool posts, "Vulcan" forged-cutter tool-holders, and several new sets of drop-forged wrenches. The book contains, in addition, a description of the drop-forging process, written in a simple, non-technical style for the benefit of those not familiar with its details.

TRADE NOTES

American Shell Co., Paterson, N. J., has changed its name to the **Gillespie Motor Co.**

Poole Engineering & Machine Co., Baltimore, Md., has opened a branch office in Boston in the Old South Building, in charge of Robert W. Catlin, district manager.

John T. Moran Machine Co., 103-107 Grape St., Syracuse, N. Y., in connection with its general jobbing and tool work, is about to place on the market a special indestructible tool handle for use with wood-working tools.

J. A. Purves & Sons, 214 Temple St., Syracuse, N. Y., has moved to new quarters at W. Jefferson and Franklin Sts., where the company will have three times the present floor space. This concern manufactures tools and special machinery.

Lyon Metallic Mfg. Co., Aurora, Ill., manufacturer of steel shelving, lockers, boxes, cabinets, and general steel equipment, announces the opening of a new district sales office in Philadelphia at 519 Bulletin Bldg., with R. J. Nyce in charge.

American Machine Products Co., Detroit, Mich., is now located in its new factory at 18th and Howard Sts., which is a modern two-story brick building with ample floor space to greatly increase the production. This company manufactures milling cutters, reamers, end-mills, three-lip drills, and special tools.

Horace G. Cooke, Inc., 50 East 42nd St., New York City, has been organized for the purpose of designing and marketing for the National Marine Engine Works, Inc., a complete line of rotary compressors, gas exhausters, and pumps. Horace G. Cooke was for twenty years eastern representative of the Connersville Blower Co.

Abrasive Co., Philadelphia, Pa., announces that the use of the name "Boro-Carbone" as applying to the aluminous abrasive made by the company will be discontinued, and this product hereafter will be marketed under the registered trademark "Borolon." The silicon-carbide abrasive will continue to be trademarked "Electrolon."

Dickey Steel Co., Inc., Woolworth Bldg., New York City, has been appointed eastern sales and export representative of the Hammond Steel Co., Inc., Syracuse, N. Y., manufacturer of high-speed, alloy, and straight carbon tool steels, and a complete line of alloy steels in bars, weldless rings, die-blocks and special shapes.

Republic Tool & Mfg. Co., 1399 W. 9th St., Cleveland, Ohio, has acquired the business of the Cleveland Power Transmission Co., the Detroit Reamer & Tool Co., the Clyde E. Lowe Co., and the Diamond Stamping Works Co. A complete line of small tools and cold-rolled steel in rounds, hexagons, squares and flats will be carried.

Gale-Sawyer Co., 36 Oliver St., Boston, Mass., is making extensions and alterations to its plant at South Weymouth, Mass. The company desires to be placed on the mailing lists of machine tool manufacturers and to be furnished with catalogues and other literature applicable to the business of manufacturing cutters, reamers, and small tools.

Ingersoll-Rand Co., 11 Broadway, New York City, has established a branch office in Dallas, Tex., located in the Sam Houston Life Building. R. H. Brown, Jr., will be in charge of the new office. Mr. Brown has heretofore been connected with the company's St. Louis office and has been in intimate touch with the Texas and Oklahoma territory for many years.

New Departure Mfg. Co., Bristol, Conn., held its fourth annual field day and barbecue September 20. The usual parade, athletic sports, dinner, and concert were features of the day. This event brings together the large number of employes of the company, which increases every year, and promotes a feeling of fellowship and good will between the management and the workers.

R. S. Stokvis & Zonen, Ltd., Rotterdam, Holland, has appointed George Roemer Woods, formerly with the Allied Machinery Co., of America, manager of the New York office at 17 Battery Place, New York City. Mr. Woods sailed in October for the United States from Europe where he has been studying industrial and economic conditions, and assumed his new duties November 1.

J. Horstmann, 83 Rue St. Maur, Paris, France, announces the appointment of Charles B. Elmore as American representative of the company with offices at 47 West 42nd St., New York City. The firm requests duplicate copies of complete catalogues, price lists and dealers' discounts from firms who desire to make arrangements for selling machine tools and machine shop equipment in France.

James Ohlen & Sons Saw Mfg. Co., Columbus, Ohio, and **George H. Bishop & Co.**, Lawrenceburg, Ind., have effected a merger and consolidation of interests, which will make it possible for them to present to the trade a complete line of saws and tools adapted for every wood- and metal-cutting purpose. The Ohlen plant at Columbus and the Bishop plant at Lawrenceburg will each be immediately enlarged to meet the increased demands for the products of these companies.

Cleveland Twist Drill Co., Cleveland, Ohio, announces that it has made a four-reel motion picture entitled "The Twist Drill—Its Uses and Abuses," which is designed primarily to be shown before machinists, drill press hands, foremen's clubs, etc. The picture deals with the fundamental principles of drilling, and among the subjects treated are body clearance, lip clearance, angle of cutting edge, feed and speed, broken tangs, and many other phases of drilling practice.

Newton Machine Tool Works, Inc., Philadelphia, Pa., have just let contracts and have now under construction a new shop covering an area of 400 by 230 feet, including an erection shop, a pattern and storage shop, a forge shop, and a power plant. The erection shop is 100 by 170 feet by 45 feet high, of steel, steel sash, and brick construction, and has one square foot of overhead light for every square foot of floor space. It will be fitted with two 50-foot span overhead traveling cranes.

Allegheny Gear Works, Chateau and Page Sts., N. S., Pittsburgh, Pa., is a newly incorporated concern that will specialize in the cutting of spur, worm, and bevel gears, in large quantities. The incorporators are W. H. Thompson, E. L. White, and O. Reflor. Mr. Thompson is treasurer and general manager, and Mr. White is secretary. A new fireproof brick and concrete building, 80 by 135 feet, is being erected, and plans are under way for rapid expansion. It is expected that manufacturing will start January 1.

Black & Decker Mfg. Co., 140 S. Calvert St., Baltimore, Md., will exhibit a complete line of the Black & Decker Lectroflater electric air compressors, portable electric drills, and electric valve grinders, at the jobbers' convention, in Chicago, in November. Air compressors, electric drills, and valve grinders, sectioned so as to show their construction and operation, will be mounted on display boards, and the various sectioned models will be operated at slow speeds in order to demonstrate the actual functioning of each part.

Zobell Electric Motor Corporation, Garwood, N. J., has been incorporated in the state of New York with a capital of $250,000. The new corporation intends to manufacture both alternating-current and direct-current motors in sizes from 1 to 7½ horsepower, having many refinements not found at this time in small motors. The president of the new company is Fred G. Bell, and the treasurer, A. T. Zoebisch, both of whom were formerly connected with the E. D. Co., of Bayonne, N. J. The superintendent is F. E. Bucker, formerly superintendent of the E. D. Co.

Leland-Gifford Co., Worcester, Mass., manufacturer of sensitive drilling machines and profiling machines, has opened a sales office at 521 Chamber of Commerce Bldg., Rochester, N. Y., in charge of A. H. Anderson. The company has transferred its Chicago office from 500 Machinery Hall to 621 W. Washington Blvd., where a store and demonstrating room are maintained. C. H. James is in charge of the store, and O. H. Leidy has recently been added to the Chicago sales force. The company intends to keep a stock in the Chicago office at all times for immediate delivery.

Bearings Co. of America, Lancaster, Pa., has decided to increase the facilities of its thrust bearing factory by erecting a new building of the latest type of construction in the immediate future, adding approximately 60,000 square feet of floor space to the present facilities. With the addition of the new buildings completed last year for the increased production of universal joints, this gives the Bearings Co. of America four separate factories—one for the manufacture of thrust ball bearings; one for "Star" ball retainers; one for "Sterling" universal joints; and one for drop-forgings.

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill., is making extensive additions to its plant and equipment, which include an addition to the drop-forge department, a new building for the hardening and heat-treating department, and a new reinforced concrete building for the general office, finished stock and shipping department. The new buildings and equipment, together with the rearrangement of the entire plant made possible thereby, will largely increase the company's production—an increase which is urgently needed to take care of the rapidly growing business.

Goddard & Goddard Co., Detroit, Mich., has removed its business to its new factory on Hastings St., at Forest Ave. The new building will afford increased room and the equipment available will make it possible for the company to render prompter service to its customers and also to handle a larger volume of business. Owing to the increasing demand for the Goddard & Goddard type of cutters, which taxes the company's capacity to its utmost, it has been decided to discontinue the salvaging of worn tools and specialize entirely on the manufacture of the Goddard & Goddard high-speed cutters.

East Iron & Machine Co., Lima, Ohio, has bought the business of the Van Wie Pump Co., Syracuse, N. Y., including the drawings, patterns, good will, etc., of the company. The Van Wie Pump Co. was established in 1860 under the name of White, Clark & Co., and in 1905 was incorporated under the present name. Its line includes vertical and horizontal centrifugal pumps, double-suction pumps, sand pumps, hydraulic pumps, single-acting triplex pumps, and vertical steam engines. The East Iron & Machine Co. will begin manufacturing this line immediately, and will make parts and repairs for all the Van Wie products.

Production Engineering Co., 212 Centre St., New York City, has been organized to act as engineers to manufacturers. The officers of the company are John A. Honegger, president; Robert Steinman, treasurer; and H. Allen Hinchcliff, secretary. The firm will specialize in the designing and building of tools and machinery for automatic production. It is desirous of obtaining catalogues of machine tool and specialty manufacturers for use in its reference files. In addition, the company wishes to get in touch with all manufacturers of standard labor-saving devices so that it may inform its clients where such standard equipment may be obtained.

Mossberg Pressed Steel Corporation has recently been organized at Attleboro, Mass., and will specialize in the manufacture of pressed steel loom beam heads, section beam heads, adjustable loom beam heads, narrow fabric beams, jack or dresser spools, and drop wires for the textile industry, as well as special stampings. The company will endeavor to develop new ideas for the improvement of textile machinery along the lines of replacing cast-iron parts that are constantly breaking, with pressed steel. The officers of the corporation are Frank Mossberg, president; S. O. Bigney, vice-president; C. A. VanderPyl, treasurer; and A. A. Underwood, secretary and sales manager. All of the officers, except Mr. Bigney, were formerly connected with the Frank Mossberg Co.

Wyckoff Drawn Steel Co. has recently been organized at Ambridge, Pa., by A. W. Wyckoff, a former steel man and distributor of Chalmers and Reo cars for several years in the Pittsburg district. The plant will have an initial capacity of 5000 tons of drawn steel per month and facilities for immediately increasing production. It is expected that the mill will be in full operation in December, and orders are now being booked for delivery the early part of next year. Modern machinery is being installed for producing cold-drawn steel products in the shape of rounds, squares, hexagons, special shapes, screw stocks, and alloy steel. The officers are A. W. Wyckoff, president; G. R. Nutty, vice-president; and Joseph T. Somers, general manager of sales.

Bridgeford Machine Tool Works, Rochester, N. Y., and **Betts Machine Co.**, formerly of Wilmington, Del., announce the consolidation of the two companies to be known as Betts Machine Co., located at Rochester, N. Y. The Bridgeford Machine Tool Works has specialized in building heavy engine lathes and axle lathes for more than twenty years in Rochester. The Betts Machine Co. has been building heavy-duty machine tools for nearly sixty years, being organized in 1861 in Wilmington, Del., and moving to Rochester in 1918. Bridgeford lathes and Betts heavy machine tools will hereafter be built by the Betts Machine Co. at its new plant in Rochester and distributed by the Betts Machine Co. from Rochester and through its offices and representatives in New York, Chicago, Cleveland, and other large cities.

Black & Decker Mfg. Co. is erecting a new plant at Towson Heights, near Baltimore, Md., which will comprise an addition to the office building recently completed, into which the general offices have been moved. The new building will be 100 feet deep by 200 feet wide, and will add 20,000 square feet of floor space to the plant's facilities, making a total of 32,000 square feet of manufacturing floor space available. The building will be of steel and brick construction, finished in stucco to conform to the residences for employes which the company is erecting, and will be provided with a monitor roof and windows extending all the way around the sides, which will supply abundant light and ventilation. It is expected that the new factory will be completed about December 1 and will be in full operation shortly after the first of the year. It is stated that sufficient additional machine equipment will be installed to give the plant more than twice the present productive capacity. The Austin Co., Cleveland, Ohio, has charge of the construction.